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ABSTRACT

Presented in this program and proceedings are the following 27 papers describing a variety of educational uses of computers: "Learner Based Tools for Special Populations" (Barbara Allen); "Micros and Mainframes: Practical Administrative Applications at the Building Level" (Jeannine Bertrand and Eric Schiff); "Logo and Logowriter in the Curriculum" (Billie H. Brown); "The Computer as Construction Kit" (Christine Chaille); "Computer Saturation: Getting More (F)or Less" (Doug Cooper); "Empowering Environments, Hypermedia and Microworlds" (Christopher Dede); "Changes on the Horizon in Data Structures" (J. Michael Dunlap); "Useful Public Domain Software for Educators" (Kurt Gustafson); "Literacy Programs Using Current Technology" (Pat Heerman); "Merging of Office Automation and Information Services" (Terry K. Hippenhammer); "CI3: Integrating the Computer-as-Tool into the Science Curriculum to Bring about Change" (Vivian P. Johnson); "Using Computers in College Mathematics Courses" (Richard M. Koch); "The Instructional Uses of Microcomputers in the State of Oregon: The Spring 1987 Assessment of the Oregon Elementary School" (William E. Lamon); "Appleworks: Special Education Student Scheduling and IEP Management" (Christian Larsen); "Networking Teachers" (Tom Layton); "Should Students Use Spelling Checkers?" (Janice Adele Meyer); "The Apple Classroom of Tomorrow" (Samuel K. Miller); "Resources for Computer Educators" (Anant Kartik Mithal); "MECC Apple Software in the Eugene School District" (Patti Nelson); "Computer Graphics Applications for Teachers" (Julia A. Poage); "Peer Conferencing, Computers, and Persuasive Writing: A Recipe to Encourage Revision" (Jane M. Ritter); "Effective Keyboarding Instruction: A Comparison of Three Programs" (Linda Shellenger); "Local Area Networks: A Classroom Solution" (Georgina L. Seals); "School Applications of Desktop Publishing" (Milt Stanley); "Adding Macro Capabilities to Appleworks" (Neal Strudler); "Understanding Simulations" (John L. Tenny); "Robots in the Elementary Curriculum"

(Elizabeth Anne Viau); "Using Robots to Teach Science" (Elizabeth Anne Viau); and "Making the Connection: Software Developers and Educators" (Nancy E. Willard). Also included is information on preconference workshops, conference sessions, and exhibitors. (CGD)

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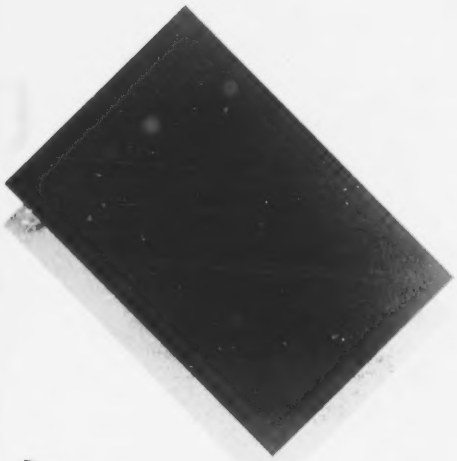
ANNUAL "EXTENDING THE HUMAN MIND: COMPUTERS IN EDUCATION" SUMMER CONFERENCE



PROGRAM & PROCEEDINGS - '87

UNIVERSITY OF OREGON

IR012981

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Program

Extending the Human Mind: Computers in Education

Sixth Annual Summer Computer Conference

Sponsored by

Center for Advanced Technology in Education

and

Continuation Center

University of Oregon

Held at the

Erb Memorial Union, University of Oregon

Eugene, Oregon

August 6 - 9, 1987

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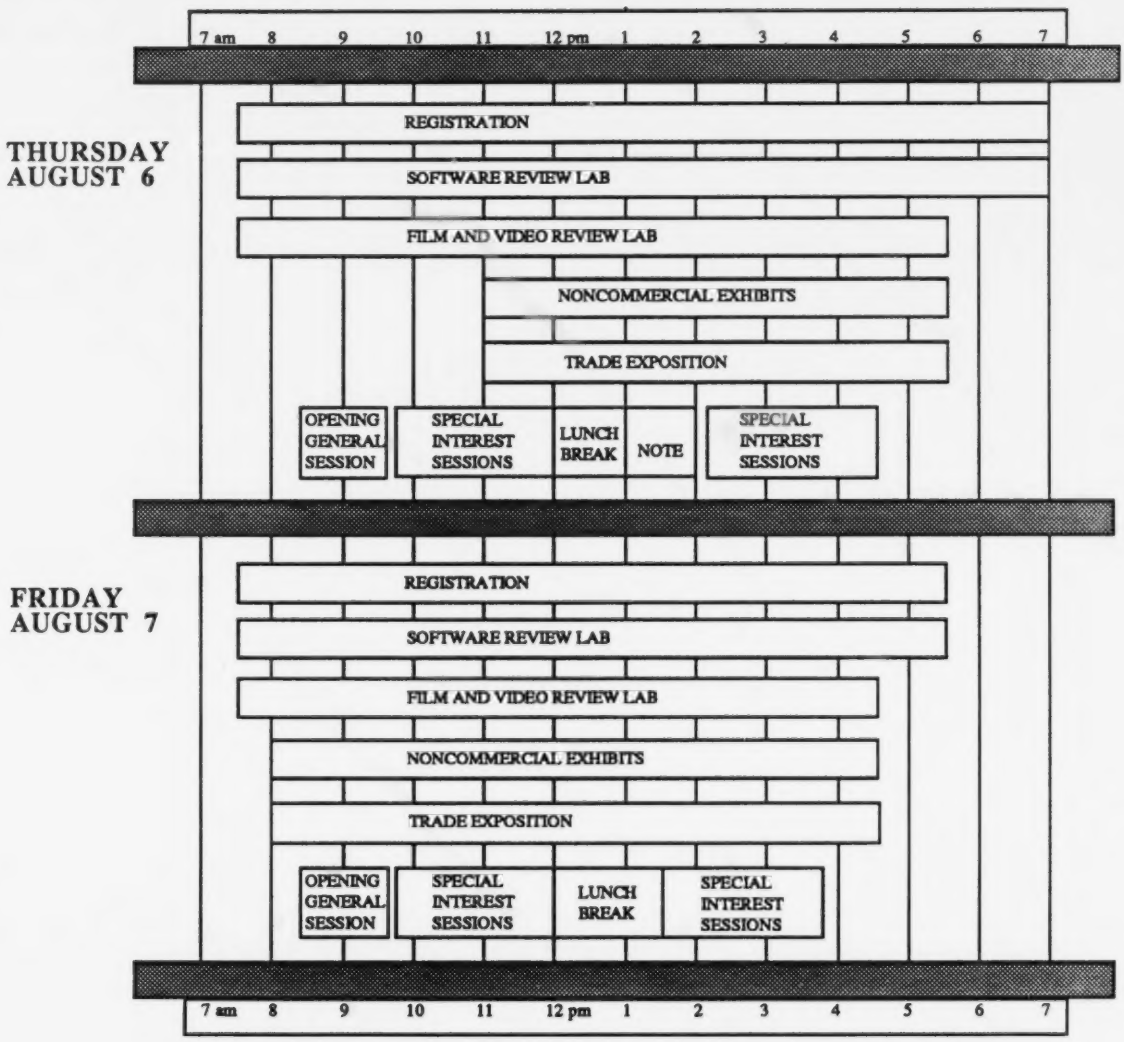
Special thanks to many volunteers.

CONFERENCE - AT - A - GLANCE



PRESENTATION SCHEDULE

THURSDAY, AUGUST 6, 1987

	8:30 - 9:30 A.M.	9:45 - 10:45 A.M.	11:00 - 12:00 P.M.	1:00 - 2:00 P.M.	2:15 - 3:15 P.M.	3:30 - 4:30 P.M.
FIR ROOM	KEYNOTE SPEAKER CHRISTOPHER DEDE "EMPOWERING ENVIRONMENTS, IDEA PROCESSORS, AND MICROWORLDS"	JANICE MEYER "SHOULD STUDENTS USE SPELLING CHECKERS"	JANICE MEYER "SHOULD STUDENTS USE SPELLING CHECKERS"	KEYNOTE SPEAKER MARGE KOSEL "TRENDS IN EDUCATIONAL COMPUTING"	TOM LAYTON "NETWORKING TEACHERS"	TOM LAYTON "NETWORKING TEACHERS"
MAPLE ROOM		CHRISTIAN LARSON "APPLEWORKS AND SPECIAL EDUCATION STUDENT SCHEDULING AND I.E.P. MANAGEMENT"	CHRISTIAN LARSON "APPLEWORKS AND SPECIAL EDUCATION STUDENT SCHEDULING AND I.E.P. MANAGEMENT"		BILLIE BROWN "LOGO AND LOGOWRITER IN THE CURRICULUM"	BILLIE BROWN "LOGO AND LOGOWRITER IN THE CURRICULUM"
OAK ROOM		DOUG COOPER "COMPUTER SATURATED CLASSROOMS: GETTING MORE (F)OR LESS?"	DOUG COOPER "COMPUTER SATURATED CLASSROOMS: GETTING MORE (F)OR LESS?"		CHRISTINE CHAILLE "COMPUTERS AS CONSTRUCTION KITS FOR PRE-SCHOOL AND PRIMARY"	CHRISTINE CHAILLE "COMPUTERS AS CONSTRUCTION KITS FOR PRE-SCHOOL AND PRIMARY"
CEDAR A & B		JEANNINE BERTRAND ERIC SCHIFF "MICROS AND MAINFRAMES: PRACTICAL ADMINISTRATIVE APPLICATIONS AT THE BUILDING LEVEL"	JEANNINE BERTRAND ERIC SCHIFF "MICROS AND MAINFRAMES: PRACTICAL ADMINISTRATIVE APPLICATIONS AT THE BUILDING LEVEL"		J. MICHAEL DUNLAP "CHANGES ON THE HORIZON IN DATA STRUCTURES"	J. MICHAEL DUNLAP "CHANGES ON THE HORIZON IN DATA STRUCTURES"
CEDAR C & D		RICHARD M. KOCH "USING COMPUTERS IN SECONDARY AND COLLEGE MATH INSTRUCTION"	RICHARD M. KOCH "USING COMPUTERS IN SECONDARY AND COLLEGE MATH INSTRUCTION"		VIVIAN P. JOHNSON "INTEGRATED COMPUTER APPLICATIONS IN SCIENCE GRADES 7-12"	VIVIAN P. JOHNSON "INTEGRATED COMPUTER APPLICATIONS IN SCIENCE GRADES 7-12"
CEDAR F		CEDAR F GEORGINA SEALS "LOCAL AREA NETWORK: A CLASSROOM SOLUTION"	CEDAR F GEORGINA SEALS "LOCAL AREA NETWORK: A CLASSROOM SOLUTION"		BARBARA ALLEN "LEARNER-BASED TOOLS FOR SPECIAL POPULATIONS"	BARBARA ALLEN "LEARNER-BASED TOOLS FOR SPECIAL POPULATIONS"
FORUM ROOM		JULIE A. POAGE "COMPUTER GRAPHICS APPLICATIONS FOR TEACHERS"	JULIE A. POAGE "COMPUTER GRAPHICS APPLICATIONS FOR TEACHERS"		NEAL STRUDLER "ADDING MACRO POWER TO APPLEWORKS"	NEAL STRUDLER "ADDING MACRO POWER TO APPLEWORKS"
BOARDROOM	Technical	Presentations	by Vendors			

Conference Sessions

Thursday, August 6, 1987

8:30 a.m. - 9:30 a.m. — **Opening General Session Presentation**

Fir Room

Dr. Christopher Dede, University of Houston - Clear Lake
Empowering Environments, Idea Processors, and Microworlds
Artificial intelligence researchers are developing "cognition enhancers" which complement human intelligence. These may reshape the workplace and the goals, content, and methods of education.

9:45 a.m. - 10:45 a.m. — **Special Interest Sessions**

Fir Room

Janice Adele Meyer, Ph.D.
Should Students Use Spelling Checkers
Presentation will describe research conducted with 11th graders to determine if electronic spelling checkers, used in conjunction with a word processing program, improved students' spelling achievement, enabled them to show an increase in expressive vocabulary and functional spelling skills, and assisted in a decrease in specific types of spelling errors.

Maple Room

Christian Larsen, Peninsula High School
AppleWorks and Special Education Student Scheduling and I.E.P. Management
This presentation will cover the development of criterion-based I.E.P.'s and the use of AppleWorks Database and Spreadsheet for student scheduling, grading, and managing I.E.P. probe data.

Oak Room

Doug Cooper
Computer Saturated Classrooms: Getting More (F)or Less?
A critical review of the computer saturated classroom as a model for future education environments.

Cedar A & B

Eric Schiff and Jeannine Bertrand, Jefferson Middle School
Micros and Mainframes: Practical Administrative Applications at the Building Level
Software applications for micros to enhance and facilitate administrative management with day to day activities will be demonstrated and discussed. VAX E-MAIL and student service systems along with specialized applications will also be demonstrated and discussed.

Cedar C & D

Richard M. Koch, Mathematics, University of Oregon
Using Computers in Secondary and College Math Instruction
Demonstration of several pieces of software useful for Mathematics teachers. What should we do with computers? What should we avoid?

Cedar E

Georgina L. Seals, Business Instructor, Illinois Valley High School
Local Area Network: A Classroom Solution
Mrs. Seals teaches in the Business Department at the high school level. Her school district is in the vanguard of schools initiating the use of a computer network to teach keyboarding, word processing, office technology, and other classes. A demonstration of the IBM and Novell network will be presented along with some application software.

Forum Room

Julie A. Poage, University of Oregon
Computer Graphics Applications for Teachers
Integration and classroom applications of computer graphics using the Apple IIe and Macintosh computers. Demonstrations will include Printshop, Dazzle Draw, Animate and Superpaint.

11:00 a.m. - 12:00 p.m. **Special Interest Sessions**

Fir Room

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1:00 p.m. - 2:00 p.m.

Keynote Address

Fir Room

Marge Kosel, Vice President, Sunburst Communications
Trends in Educational Computing
A publisher must constantly be looking at the market, evaluating the trends and making decisions based on them. What do we see? Where are schools going? What's good, what needs improvement? How can we change? She will present some thoughts about educational computing.

2:15 p.m. - 3:15 p.m.

Special Interest Sessions

Fir Room

Tom Layton, Computer Specialist, South Eugene High School
Networking Teachers
Networking teacher computer workstations at the high school level. Connecting Macintoshes with AppleTalk, PhoneNET, AppleShare, InterMail, ModemShare, and a Digital MicroVAX.

Maple Room

Billie H. Brown, Computer Teacher, Spencer Butte Middle School
Logo and LogoWriter in the Curriculum
Logo and LogoWriter can be used to add excitement and understanding to various areas of the curriculum: Language Arts, Math, Literature, Science, Social Studies.

Oak Room

Christine Chaille, Associate Professor, Teacher Education, University of Oregon
Computers as Construction Kits for Pre-school and Primary
An examination of software that creates contexts for experimentation and theory-building.

Cedar A & B

J. Michael Dunlap, Willamette University
Changes on the Horizon in Data Structures
Data structure teaching approaches are improving. This talk examines the latest content and methodology for Advanced Placement computer science.

Cedar C & D	**Vivian P. Johnson,** Research Assistant, University of Oregon ***Integrated Computer Applications in Science Grades 7-12*** Demonstration of classroom materials developed for use with an integrated software package. The demonstration will be followed with a discussion of design principles employed in development of materials.
Cedar F	**Barbara Allen,** Speech/Language Pathologist ***Learner-Based Tools for Special Populations*** The focus will be on open-ended software which permit the user to control the learning activity or communication interaction. Included will be a report on activities conducted during the past year at the University of Virginia/IBM Institute.
Forum Room	**Neal Strudler,** University of Oregon ***Adding "Macro Power" to AppleWorks*** This session will explore how Super MacroWorks and other macro programs make AppleWorks faster and more powerful.
3:30 p.m. - 4:30 p.m.	**Special Interest Sessions**
Fir Room	**Tom Layton,** Computer Specialist, South Eugene High School ***Networking Teachers*** Networking teacher computer workstations at the high school level. Connecting Macintoshes with AppleTalk, PhoneNET, AppleShare, InterMail, ModemShare, and a Digital MicroVAX.
Maple Room	**Billie H. Brown,** Computer Teacher, Spencer Butte Middle School ***Logo and LogoWriter in the Curriculum*** Logo and LogoWriter can be used to add excitement and understanding to various areas of the curriculum: Language Arts, Math, Literature, Science, Social Studies.
Oak Room	**Christine Chaille,** Associate Professor, Teacher Education, University of Oregon ***Computers as Construction Kits for Pre-school and Primary*** An examination of software that creates contexts for experimentation and theory-building.
Cedar A & B	**J. Michael Dunlap,** Willamette University ***Changes on the Horizon in Data Structures*** Data structure teaching approaches are improving. This talk examines the latest content and methodology for Advanced Placement computer science.
Cedar C & D	**Vivian P. Johnson,** Research Assistant, University of Oregon ***Integrated Computer Applications in Science Grades 7-12*** Demonstration of classroom materials developed for use with an integrated software package. The demonstration will be followed with a discussion of design principles employed in development of materials.

Cedar F	**Barbara Allen,** Speech/Language Pathologist ***Learner-Based Tools for Special Populations*** The focus will be on open-ended software which permit the user to control the learning activity or communication interaction. Included will be a report on activities conducted during the past year at the University of Virginia/IBM Institute.
Forum Room	**Neal Strudler,** University of Oregon ***Adding "Macro Power" to AppleWorks*** This session will explore how Super MacroWorks and other macro programs make AppleWorks faster and more powerful.

PRESENTATION SCHEDULE

FRIDAY, AUGUST 7, 1987

	8:30 - 9:30 A.M.	9:45 - 10:45 A.M.	11:00 - 12:00 NOON	12:00 - 1:30 P.M.	1:30 - 2:30 P.M.	2:45 - 3:45 P.M.
FIR ROOM	KEYNOTE SPEAKER DAVID M. MARQUART "TEACHER IN SPACE PROGRAM: TECHNOLOGY OF THE FUTURE"	LINDA SCHELLENGER "TEACHING KEYBOARDING: HOW TO'S, TIPS AND TECHNIQUES"	LINDA SCHELLENGER "TEACHING KEYBOARDING: HOW TO'S, TIPS AND TECHNIQUES"		WILLIAM E. LAMON "THE INSTRUCTIONAL USES OF MICROCOMPUTERS IN THE STATE OF OREGON"	WILLIAM E. LAMON "THE INSTRUCTIONAL USES OF MICROCOMPUTERS IN THE STATE OF OREGON"
MAPLE ROOM		PAT HEERMAN "LITERACY PROGRAMS, WRITING TO READ"	PAT HEERMAN "PRINCIPLE OF THE ALPHABET LITERACY SYSTEM"		JOHN L. TENNY "SIMULATIONS IN THE CLASSROOM"	JOHN L. TENNY "SIMULATIONS IN THE CLASSROOM"
OAK ROOM			DAVID M. MARQUART "EXPLORING THE SPACE FRONTIER"		NANCY WILLARD "MAKING THE CONNECTION: SOFTWARE DEVELOPERS AND EDUCATORS"	NANCY WILLARD "MAKING THE CONNECTION: SOFTWARE DEVELOPERS AND EDUCATORS"
CEDAR A & B		TERRY HIPPENHAMMER "MERGING OF OFFICE AUTOMATION AND INFORMATION SYSTEMS"	TERRY HIPPENHAMMER "MERGING OF OFFICE AUTOMATION AND INFORMATION SYSTEMS"		ANANT KARTIK MITHAL "RESOURCES FOR COMPUTER EDUCATORS"	ANANT KARTIK MITHAL "RESOURCES FOR COMPUTER EDUCATORS"
CEDAR C & D		SAM MILLER "IMPLEMENTATION & FINDINGS OF THE APPLE CLASSROOM OF TOMORROW"	SAM MILLER "IMPLEMENTATION & FINDINGS OF THE APPLE CLASSROOM OF TOMORROW"		MILT STANLEY "SCHOOL APPLICATIONS OF DESKTOP PUBLISHING"	MILT STANLEY "SCHOOL APPLICATIONS OF DESKTOP PUBLISHING"
CEDAR F		BOB VERK "CREATING AND USING NEW DATA BASES IN THE SOCIAL SCIENCES"	BOB VERK "CREATING AND USING NEW DATA BASES IN THE SOCIAL SCIENCES"		DR. JANE M. RITTER "A COMPUTER-FACILITATED CONFERENCING TECHNIQUE TO ENCOURAGE REVISION"	DR. JANE M. RITTER "A COMPUTER-FACILITATED CONFERENCING TECHNIQUE TO ENCOURAGE REVISION"
FORUM ROOM		PATTIE NELSON "BEST OF MECC"	PATTIE NELSON "BEST OF MECC"		KURT GUSTAFSON "PUBLIC DOMAIN SOFTWARE FOR EDUCATORS"	KURT GUSTAFSON "PUBLIC DOMAIN SOFTWARE FOR EDUCATORS"
BOARDROOM	**Technical Presentation:** 8:00 - 9:00 a.m.	ELIZABETH VIAU "USING ROBOTS IN YOUR SCIENCE PROGRAM"	ELIZABETH VIAU "ROBOTS IN THE ELEMENTARY CURRICULUM"	Technical	Presentations	by Vendors

Conference Sessions

Friday, August 7, 1987

8:30 a.m. - 9:30 a.m. — **Opening General Session Presentation**

Fir Room

David Marquart, Teacher in Space, NASA
The Teacher in Space Program: Technology for the Future
A discussion of NASA's use of computers and the ways in which computers, and technology in general, are sure to affect our futures.

9:45 a.m. - 10:45 a.m. — **Special Interest Sessions**

Fir Room

Linda Schellenger, Beaverton School District Media Specialist
Teaching Keyboarding: How To's, Tips and Techniques
What factors are crucial in implementing a keyboarding curriculum? How can students' progress at the elementary or middle school level be evaluated effectively? A comparison of three keyboarding programs will provide the basis for discussion of the practical aspects of teaching keyboarding skills.

Maple Room

Pat Heerman, Advisory Systems Engineer, IBM Corp.
Literacy Programs, Writing to Read
Writing to Read is a multisensory system than develops writing and reading skills for children in the kindergarten or first grade.
Principle of the Alphabet Literacy System
Principle of the Alphabet Literacy System is an interactive instructional program to improve the reading and writing skills of participants with a reading level below the sixth grade.

Cedar A & B

Terry K. Hippenhammer, Director, Computing and Information Services, Eugene School District 4J
Merging of Office Automation and Information Systems
Technology is available for organizations to design a comprehensive organization-wide communication system which includes electronic mail, office automation tools, and information systems. The Eugene School District 4J has initiated an aggressive plan to implement combined office automation and information systems district wide.

Cedar C & D

Sam Miller, ACOT Coordinator, Colin Kelly Middle School
Implementation and Findings of the Apple Classroom of Tomorrow
Participants will receive an overview of Eugene's Apple Classroom of Tomorrow during the past two years.

Cedar F

Bob Veeck, Teacher, Eugene's International High School
Creating and Using New Data Bases in the Social Studies
An explanation of how to develop and use data bases entitled: The Power of Nation-States, Nuclear Decisions, and Global History.

Forum Room

Pattie Nelson, Magladry Computer Lab Assistant, Eugene School District

Best of MECC

If you are in need of Apple software ideas, join us in an overview of the MECC programs most recently released. From pre-reading and math readiness for the primary grades to data base searching for middle school students to teacher management tools, MECC has much to offer. You will see software demonstrated and receive ideas for using the program and sources of lesson plans.

Boardroom

Elizabeth Anne Viau, Ph.D., Coker College

Using Robots in Your Science Program

Robotic toys are designed to solve some of the problems that living creatures have contended with. Add spice to your science program by thinking about robots!

11:00 a.m. - 12:00 a.m.

Special Interest Sessions

Fir Room

Linda Schellenger, Beaverton School District Media Specialist

Teaching Keyboarding: How To's, Tips and Techniques

What factors are crucial in implementing a keyboarding curriculum? How can students' progress at the elementary or middle school level be evaluated effectively? A comparison of three keyboarding programs will provide the basis for discussion of the practical aspects of teaching keyboarding skills.

Maple Room

Pat Heerman, Advisory Systems Engineer, IBM Corp.

Literacy Programs, Writing to Read

Writing to Read is a multisensory system than develops writing and reading skills for children in the kindergarten or first grade.

Principle of the Alphabet Literacy System

Principle of the Alphabet Literacy System is an interactive instructional program to improve the reading and writing skills of participants with a reading level below the sixth grade.

Oak Room

Dave Marquart, Teacher in Space, NASA

Pioneering the Space Frontier

A look into the future and the challenges needed for teachers in the next century.

Cedar A & B

Terry K. Hippenhammer, Director, Computing and Information Services, Eugene School District 4J

Merging of Office Automation and Information Systems

Technology is available for organizations to design a comprehensive organization-wide communication system which includes electronic mail, office automation tools, and information systems. The Eugene School District 4J has initiated an aggressive plan to implement combined office automation and information systems district wide.

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Boardroom

Elizabeth Anne Viau, Ph.D., Coker College
Robots in the Elementary Curriculum
Inexpensive, widely available robotic toys can be used to stimulate question formulation and the discovery of problems in many curricular areas. See a collection of robots!

1:30 p.m. - 2:30 p.m.

Special Interest Sessions

Fir Room

William E. Lamon, Ph.D., Division of Teacher Education
The Instructional Uses of Microcomputers in the State of Oregon: The Spring 1987 Assessment!
Financially supported by the State Department of Education, the University of Oregon and the Oregon Educational Computer Consortium (OECC), a detailed survey was conducted in the Spring of 1987 in Oregon of the use of microcomputers in instruction. The findings will be presented

Maple Room

John L. Tenny, Willamette University
Simulations In The Classroom
Types of simulations and how to select and use them in the classroom will be discussed.

Oak Room

Nancy Willard, Attorney
Making the Connection: Software Developers and Educators
Cooperative efforts between educators and software developers can result in high quality, educationally-sound software. This presentation will focus on the mechanics of the developer / educator / school district relationship.

Cedar A & B

Anant Kartik Mithal
Resources for Computer Educators
In today's world, how should computer educators a) learn about the ideologies of leaders in the field and b) keep abreast of rapidly changing events?

Cedar C & D

Milt Stanley, Computer Studies Coordinator
School Applications of Desktop Publishing
This presentation will include: 1) a brief description of the hardware and software configurations available for microcomputer-based publishing systems, 2) a description of the Kaslo School Computer Lab setup and a locally developed unit of study on desktop publishing, and 3) a discussion of administrative and instructional applications of microcomputer-based publishing systems.

Cedar F

Dr. Jane M. Ritter
A Computer-Facilitated Conferencing Technique to Encourage Revision
During oral peer group conferences with 5th graders, the insertion of comments into text at the computer serves as a reminder of ideas discussed during the conference. This conferencing technique encourages meaning-related revisions in subsequent drafts.

Forum Room

Kurt Gustafson, Greater Albany Public Schools
Public Domain Software for Educators
Feeling daunted by low budgets and high software costs? A good alternative is inexpensive public domain software.

2:45 p.m. - 3:45 p.m.

Special Interest Sessions

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Nancy Willard, Attorney
Making the Connection: Software Developers and Educators
Cooperative efforts between educators and software developers can result in high quality, educationally sound software. This presentation will focus on the mechanics of the developer / educator / school district relationship.

Cedar A & B

Anant Kartik Mithal
Resources for Computer Educators
In today's world, how should computer educators a) learn about the ideologies of leaders in the field and b) keep abreast of rapidly changing events?

Cedar C & D

Milt Stanley, Computer Studies Coordinator
School Applications of Desktop Publishing
This presentation will include: 1) a brief description of the hardware and software configurations available for microcomputer-based publishing systems, 2) a description of the Kaslo School Computer Lab setup and a locally developed unit of study on desktop publishing, and 3) a discussion of administrative and instructional applications of microcomputer-based publishing systems.

Cedar F

Dr. Jane M. Ritter
A Computer-Facilitated Conferencing Technique to Encourage Revision
During oral peer group conferences with 5th graders, the insertion of comments into text at the computer serves as a reminder of ideas discussed during the conference. This conferencing technique encourages meaning-related revisions in subsequent drafts.

Forum Room

Kurt Gustafson, Greater Albany Public Schools
Public Domain Software for Educators
Feeling daunted by low budgets and high software costs? A good alternative is inexpensive public domain software.

Trade Exposition Hall

Commercial Exhibitors

Erb Memorial Union - Ballroom

August 6: 11:00 a.m. - 5:30 p.m.

August 7: 8:00 a.m. - 4:30 p.m.

Access Computer & Software
P.O. Box 1104
Cottage Grove, OR 97424
(503) 942-2083
Representatives: Hal Holbrook, Carol Holbrook, Hollye Holbrook

Featured will be a low-cost personal computer system, including a Laser 128 Personal Computer, Zenith Amber Monitor, and a Citizen 120D Printer. In addition, a complete line of printers, such as Citizen, Panasonic, and Star Micronics, will be displayed. The new Toshiba T-1000 Lap Computer with super twist LCD screen, 512K memory and 720K 3.5 drive, the Toshiba Printers, and the Cordata Slimline AT Computer will be shown. Special conference prices are available and for orders received at the conference there will be no shipping charge.

Allemand Construction
Rt. 1, Box 3074
Walla Walla, WA 99362
(509) 529-9234
Representative: Donald R. Allemand

A variety of computer tables made from strong MDF board with durable polyester coverings will be displayed. These tables can be used for the office, school classroom, or home.

Apple Computer, Inc.
4000 Kruse Way Place, Suite 100
Lake Oswego, OR 97035
(503) 635-7711
Representatives: Mary Erichsen, Wayne Clawson, Mark Reagan, Pam Meyer

A networking of Macintoshes with a LaserWriter will be displayed. Also shown will be the Apple II and the Imagewriter. Desktop publishing, administrative productivity, and business and classroom applications will be displayed, especially featuring MacSchool. MacSchool is a Macintosh based school administration package including student records, attendance, grades, scheduling, library, and report generation.

Digital Equipment Corp.
72 Centennial Loop
Eugene, OR 97401
(503) 687-2260
Representative: Keith Pettingill

Earthware
P.O. Box 30039
2386 Spring Blvd.
Eugene, OR 97403
(503) 344-3383
Representatives: Donna Goles, Ed Goles

Displayed will be the Apple IIgs version of the simulation entitled "Volcanoes®". Free demo disks of the "Volcanoes" program will be available, these disks are an IBM compatible version. This program can be displayed in a lab setting or can speak briefly on science education outside the lab. Catalogs will also be available.

Educational Activities, Inc.
1937 Grand Avenue
Baldwin, NY 11510
(800) 645-3739
Representative: Vince Coleman

A variety of microcomputer software, videos, filmstrips, cassette workbook programs, records, and books will be displayed with applications mainly for instructional use in the classroom or lab. A free 30-day preview on all software to schools will be given.

Educational Resources
2360 Hassell Road
Hoffman Estates, IL 60195
(800) 624-2926
Contacts: Sandra Wahl, Forest Barbieri

Come see the educational computer software and supplies at the lowest prices in the country! All educators presently using computers or planning to use computer, who want to save money and receive the best selection and service in the industry, please pick up our catalog.

Glen Canyon Software Services
2469 Glen Canyon Road
Altadena, CA 91001
(714) 794-4320
Representatives: Mike Speiser, Ann Hartry, Dylan Ashe, Greg Russell

Macintosh +, Macintosh SE and the Macintosh II will be demonstrating MacControl Facility Management software. MacControl is a package designed to take the headache out of computer facility management. Similar in many ways to a library check-out system, MacControl manages not only software and station assignment, but reservations for stations and the opening and closing of the facility.

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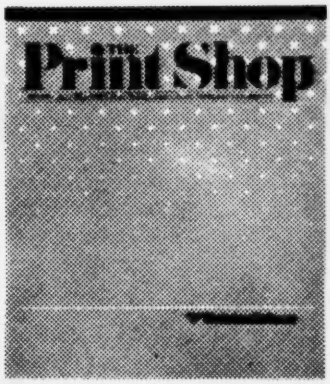
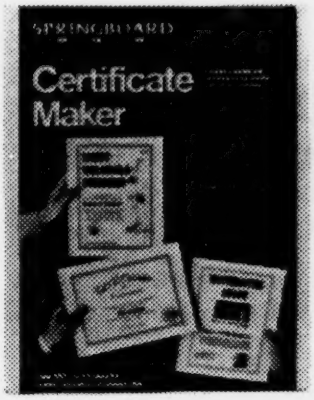


Your Cost
$27.95 APL/C64 $35.95 IBM



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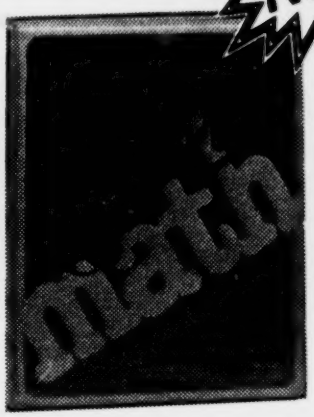
$28.95 APL/C64 $35.95 IBM/MAC



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IBM

P.O. Box 10698
111 W. 7th Avenue
Eugene, OR 97440
(503) 484-3300
Representative: Cynthia Landeen

The personal computer IBM PS/30 and the IBM PS/50 will be shown with some educational software designed for classroom networking.

International Council for Computers in Education

University of Oregon
1787 Agate Street
Eugene, OR 97403
(503) 686-4414
Representatives: Anita Best, Kathleen Geygan

ICCE booklets, packets, and monographs will be displayed targeting specific grade levels, content areas, and inservice sessions. SIG publications, ICCE catalogs and the *Appleworks for Educators* workbook will also be shown. *The Computing Teacher*, journal conference issue, addresses both beginning and advanced computer educators in the K-12 curriculum. The journal is published 9 times per year. ICCE is the largest professional organization for computer educators at the precollege level. It is non-profit, supported by 14,000 individual members and more than 50 organizations of computer-using educators worldwide.

Learning Services, Inc.

P.O. Box 10636
Eugene, OR 97440
(503) 683-3827
Representatives: John Crowder, Eric Pearson

LEARNING SERVICES is a Eugene, Oregon based company designed to meet the computer needs of educators. LEARNING SERVICES offers a complete product line of software, computers, accessories, supplies, peripherals, and robotics for Apple, Macintosh, IBM and Commodore computers at discount prices. Free shipping is available in the continental U.S.A. excluding hardware and paper products. Call or write for a free catalog. For ordering call toll-free 1-800-435-3276 (USA) or 1-800-545-3276 (Oregon).

Logic eXtension Resources

9651-C Business Center Drive
Rancho Cucamonga, CA 91730-4537
(714) 980-0046
Representatives: John Bredehoft, Bill Lair

measureUP is a test generation software package designed for the Macintosh computer family. measureUP brings full desktop publishing capabilities to teachers, trainers, and evaluators for constructing tests. measureUP combines graphics, word processing, and database management functions to provide quick and professional generation of tests. measureUP features the ability to mix many question formats. Questions may contain simple or complex graphics and the graphics may overlay text. Text fonts, sizes, and styles are fully selectable. measureUP provides for tracking of item statistics and remedial training information on a question-by-question basis. Tests are easily designed by a point-and-click method or automatically by specifying the number of questions that are to be covered for each training objective. Question may be screened based on any user-specified criteria. measureUP features complete output formatting including printing page headers and footers, correct answers, and training prescriptions. Special instructions may be placed anywhere throughout the test. Any output may be previewed on the screen prior to printing.

MorTech
P.O. Box 1239
Albany, OR 97321
(503) 758-3276
Representatives: David G. Moore, Michael D. Moore

Displayed will be the MorTech CONTROLLER™ II featuring applications in robotics. It also controls CAPSELA, ROBOTIX, and LEGO Technics construction kits through the Apple II game port.

M.S. Systems, Inc.
1895 NW 9th Street
P.O. Box 1084
Corvallis, OR 97339
(503) 754-8468
Representatives: Nelie Vance, Betty Keim, Gary Swanson

Featuring applications in desktop publishing, computer aided design and networking, many different pieces of equipment and software will be shown. Included will be Xerox Ventura Publisher, PageMaker, Hewlett Packard LaseJet II, Hewlett Packard Scanner, Novell, AutoCAD, Viking Moniterm Monitor, AST Premium/286, Leading Edge Model D, and Zenith 181. M.S. Systems, Inc. has been awarded a contract to supply the State of Oregon with Zenith, Leading Edge, Ast, Citizen and NEC microcomputer products for one full year ending April 19, 1988.

National Computer Systems
4401 W. 76th Street
Minneapolis, MN 55435
(612) 830-7704
Representatives: Bill Fullilove, Frank Edmonds, Bob McCormic

A stand alone Test Scoring machine for Surveys and Standardized Tests will be displayed.

Robert McNeel & Associates
1022 Yale Avenue North
Seattle, WA 98109
(206) 628-8822
Representative: Steve Monson

A demonstration of AutoCAD software and the full CAD workstation will be displayed, featuring applications in drafting software for engineering, architectural, mechanical design, mapping and electrical will be displayed. Robert McNeel and Associates are the software MFG's (Autodesk, Inc.) educational representative for Washington, Oregon and Alaska. They are a full service AutoCAD dealer providing hardware, software, peripheral equipment and training. Catalogs for third party software applications will be available at no charge.

Sierra Software Systems
1177 West Hastings Street, Suite 1009
Vancouver, BC V6E-2K3
(604) 682-0994
Representative: Leslie McIntosh

The Student Administration System software will be displayed. This software is currently being used by the Eugene Public School System.

United States Software Corporation
14215 N.W. Science Park Drive
Portland, OR 97229
(503) 641-8446
Representatives: Donald L. Dunstan, Diane S. Dunstan

Featuring multi-user access to PC applications, a Local Area Network will be shown.

Velan, Inc.
849 Independence Avenue
Mountain View, CA 94043
(415) 960-3388
Representatives: Bob Otto, Gene Hackett

VELAN Classroom Network system, with Apple II, IIe, IIgs, Macintosh, IBM PC/AT computers and printers working together in a classroom situation will be displayed.

Visible Software
22 The Western Way
Princeton, NJ 08540
(609) 683-4386
Contacts: Willett Kempton

Free brochures and reviews on Dr. Pascal™ will be available. Dr. Pascal is a programming system for writing pascal programs and learning how programs work.

WordPerfect Corporation
288 W. Center Street
Orem, UT 84057
(801) 227-4020
Representatives: Angie Gillman, Susan Oftedahl

WordPerfect, as well as other word processing software, will be on display. A special educational account pricing and program will also be available.

Zenith Data Systems
300 120th Avenue, N.E.
Bldg. 1, Suite 205
Bellevue, WA 98005
(206) 453-5388
Representatives: Mary Verdurmen, Gary Gitzen

A full line of microcomputers featuring Z181 and the Eazy-PC will be shown.

Zenith PC's Have Been Elected To Office In Nineteen States.

The votes are still coming in. From the Carolina coast to the California shores, Zenith PC's are taking the country by storm. With everything from a battery-operated hard drive laptop to a sophisticated 386. Already 19 states are powering their programs and setting their priorities with Zenith Data Systems. And the campaign is picking up speed everyday.

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Garry Gitzen
Dealer Sales Rep
K-12 Program
1-503-538-6825

Mary Verdurmen
Account Representative
Colleges & Universities
1-206-453-5388

Technical Presentations Schedule

Erb Memorial Union - Boardroom

Thursday, August 6, 1987

12:00 p.m. **The Future of Simulations**
Donna Goles, Earthware Computer Services
P.O. Box 30039
2386 Spring Blvd.
Eugene, OR 97403
(503) 344-3383

Discussion of the simulation as a tool for teaching. Specific illustration of the product "Volcanoes®." Both the original program and the new Apple IIgs version will be shown.

1:00 p.m. **Desktop Publishing on the IBM PC and PC Compatibles**
Nelie (Naylee) Vance, MS Computer Systems Inc.
1895 NW 9th Street
Corvallis, OR 97339
(800) 824-1110

Xerox Ventura Publisher will be demonstrated. This presentation also serves as an overview of where desktop publishing has come from, where it is, and where it is going.

2:00 p.m. **Data Projection Panels for Apple and IBM Computers**
John Crowder, Learning Services
P.O. Box 10636
Eugene, OR 97440
(503) 683-3827

Presentation to cover an update of "Data Projection Panels" that are currently on the market. Applications, and pros and cons to be covered.

3:00 p.m. **AutoCAD in Education**
Craig Dodge, MS Computer Systems Inc.
1895 NW 9th Street
Corvallis, OR 97339
(800) 824-1110

Microbased Computer-aided Design (CAD) systems are now in the classroom. Discussion of what these systems include, their capabilities, and their costs will be presented. Also stressed will be benefits to the students and school. Questions welcomed.

4:00 p.m. **Public Domain Software on File**
Hal Holbrook, Access Computers and Software
P.O. Box 1104
Cottage Grove, OR 97424
(503) 942-2083

Public Domain Software on File will be demonstrated and discussed. This package contains over 250 programs and contains support literature.

Friday, August 7, 1987

8:00 a.m. **Sierra Software Systems - The Total Student Administration Package**
Leslie McIntosh, Sierra Software Systems
1177 West Hastings St., Suite 1009
Vancouver, BC V6E 2K3
(604) 682-0994

An overview of Sierra's Student Administration System student records, attendance, registration, grade reporting, and student scheduling. A look at how the system is being used in Eugene Public Schools.

12:00 p.m. **Robotics in K-12 Education**
Dave Moore, MorTech
P.O. Box 1239
Albany, OR 97321
(503) 758-3276

Robotics is an increasingly important aspect of our technical society. Elementary and secondary schools are now investigating this field through computer literacy, physical science, and industrial education courses. This presentation will review the use of an inexpensive robotic controller for the Apple II with applications specific to this field.

1:00 p.m. **Low Cost Networking and Multiplexing**
Stewart Hunt, United States Software Corporation
14215 N.W. Science Park Drive
Portland, OR 97229
(503) 641-8446

This presentation describes and demonstrates an economical solution to both the multi-computer networking problem and the common device multiplexing problem.

2:00 p.m. **Data Projection Panels for Apple and IBM Computers**
John Crowder, Learning Services
P.O. Box 10636
Eugene, OR 97440
(503) 683-3827

Presentation to cover an update of "Data Projection Panels" that are currently on the market. Applications, and pros and cons to be covered.

The views expressed by these presenters are entirely their own and do not necessarily represent those of the Conference sponsors.

Howard Elementary School Lab Schedule

Thursday, August 6

8:00 am - 12:00 pm **Language Arts**
Teachers: Rick Peterson
Bob Benson
Pam Lee
Carol Greig Pitetti

12:00 pm - 4:00 pm **Math***
Teachers: Dorothy Robbins
Mary Tomlinson
Marilyn Husser
Carol Greig Pitetti

*Kindergarten Computer Curriculum

Friday, August 7

8:00 am - 12:00 pm **Problem Solving**
Teachers: Jeanne Kennett
Mike Plouff

12:00 pm - 3:00 pm **Mechanics***
Teachers: Jeanne Kennett
Mike Lazar

Howard Elementary School teachers and students will be conducting demonstration lessons using computers. Software representing math, language arts, problem solving and mechanics (graphics, word processing, etc.) will be demonstrated by elementary school students. Howard staff will be available to answer questions, and help with software. Visitors are welcome to work with students, observe, and ask questions. Marge Kosel, Vice President of Sunburst Communications, will be available to answer questions.

Howard Elementary School Students

Kelle Nelson	Genny Fields	Mark Tracy
Tim Lowery	Geoff Larson	Charlie Burnett
Berglind Magnusdottir	Kaylynn Nelson	David Wines
Alex Habliston	Emily Stribbling	Jennifer Godwin
Justin Dudenhoefer	Annalisa Atkins	Mark Stephens
Annika Parrott	Eric Tengs	Katie Tengs
Doug Hathaway	David McCullen	Jascha Kaykas
Garett Gildersleeve	Christopher Mellott	Robert Stowaser

Software Review Lab

Erb Memorial Union - Gumwood Room

August 6, 1987: 8:00 a.m. - 5:30 p.m.
August 7, 1987: 8:00 a.m. - 4:30 p.m.

The popular Software Review Lab returns this year, replete with educational, managerial, and administrative commercial and public domain software. An experienced staff will be on hand to help answer questions and assist in the exploration of software.

CATE Resource Center hosts a collection of over 800 pieces of educational software for the Apple IIe, Apple Macintosh, Commodore 64, and IBM-PC. Public domain software is also available to copy for the price of a blank disk. Speaker Kurt Gustafson's public domain software will be available after his session on Friday.

A representative sample of educational software, available to the Eugene school district for the Apple II series, will be available for review. The Apple IIgs computer which also uses this software will be available.

The Continuation Center will supply a large variety of Macintosh software for administration and simulation applications.

Noncommercial Exhibits

Erb Memorial Union - Ballroom

Appleugene

P.O. Box 21026
Eugene, OR 97402
(503) 683-8397

August 6th: 11:00 a.m. - 5:30 p.m. August 7th: 8:00 a.m. - 4:30 p.m.

Representatives from Appleugene will be available to answer questions about user groups. *Appleskinner Newsletter* will be displayed and any exchanges of newsletters from other user groups are welcomed.

Center for Advanced Technology in Education (CATE)

University of Oregon
1787 Agate Street
Eugene, OR 97403
(503) 686-3468

August 6th: 11:00 a.m. - 5:30 p.m. August 7th: 8:00 a.m. - 4:30 p.m.

CATE is a consortium of university, community, and state organizations established by the Oregon State Board of Higher Education to provide service, research, evaluation, and instruction in the application of advanced technology in education. Its conferences and workshop programs have served nearly 4000 people in topics ranging from keyboarding to brain research.

CATE has established the best Resource Center in the state with a ready reference library of more than 80 periodicals and more than one thousand books on computers and other technology in education. The Resource Center houses eight different microcomputers and an extensive library of educational software (available for viewing in the Conference's Software Review Lab).

Information will be available on courses of study, workshops, conferences and research programs.

Career Information System

University of Oregon
1787 Agate Street
Eugene, OR 97405
(503) 686-3872

August 6th: 11:00 a.m. - 5:30 p.m. August 7th: 8:00 a.m. - 4:30 p.m.

The Career Information System (CIS) is a computerized information base composed of current and localized information about occupations, job search techniques, post-secondary programs study and post-secondary schools. Widely used in guidance and career education, CIS is also a useful tool for instruction and administration.

Continuation Center

University of Oregon
Oregon Hall, Room 333
Eugene, OR 97403
(503) 686-4231

University of Oregon
1553 Moss Street
Eugene, OR 97403
(503) 686-3537

August 6th: 11:00 a.m. - 5:30 p.m.

August 7th: 8:00 a.m. - 4:30 p.m.

The University of Oregon's Continuation Center was established to organize, coordinate, and promote educational programs. The programs are developed to serve the campus and meet the needs of the community. The Continuation Center has three divisions: Continuing Education, the Community Education Program, and Summer Session.

The Continuing Education Program offers a wide range of educational activities including credit and noncredit lectures, conferences, seminars, workshops, formal courses, and degree and certificate programs. These activities are offered throughout the calendar year on campus, in adjacent states, in Canada, and as distant as Guam. Continuing Education has a tradition of serving the needs of teachers and school administrators and has recently gained a reputation for high-quality microcomputer instruction. This program is based at the Moss Street office.

The Community Education Program serves the needs of part-time degree students and community members wanting to take a course or two without enrolling in the University. Each term the program offers a selection of classes from all departments of the University. In addition, many departments open their entire course offerings for community education registration. Participants may take up to seven credits per term with no formal admission required. This program is based at the Oregon Hall office.

Summer Session at the University of Oregon is carefully designed to meet the varying needs of a wide range of students. Continuous activities offer an attractive and comprehensive array of courses, workshops, and seminars. Formal admission to the University is not required and all students pay in-state tuition. This program is based at the Oregon Hall office.

ERIC Clearinghouse on Educational Management

University of Oregon
1787 Agate Street
Eugene, OR 97403-5207
(503) 686-5043

August 6th: 11:00 a.m. - 5:30 p.m.

August 7th: 8:00 a.m. - 4:30 p.m.

The Educational Resources Information Center (ERIC) is designed to provide users with ready access to primarily English-language literature on education. Literature access is through a variety of products and services, such as databases, abstract journals, microfiche, computer searches, online access, document reproductions, analyses, and syntheses. A representative from ERIC will demonstrate procedures for using the ERIC database through DIALOG information services. Free materials from the ERIC Clearinghouse on Educational Management will be available, as well as sign-up sheets for the ERIC mailing list.

Eugene Public Schools

200 North Monroe Street
Eugene, OR 97401
(503) 687-3261 - North Eugene High School

August 6th: 11:00 a.m. - 5:30 p.m. August 7th: 8:00 a.m. - 4:30 p.m.

Phil Kessinger will be demonstrating the Videodisc Player and monitor, and the Interactive Video display - a computer with a simple authoring system. Various videodiscs will be displayed, including a DRAW disc. Phil Kessinger is also be representing SIGVIM (Special Interest Group for Videodisc-Microcomputer) with ICCE (International Council for Computers in Education). Newsletter and membership information will be available.

Free Literature

Numerous free pamphlets and brochures from software, film and other computer-related companies are available in the Ballroom.

Oregon School Boards Association

ORE-NET
1201 Court Street N.E.
Salem, OR 97301
(503) 588-2800

August 6th: 11:00 a.m. - 5:30 p.m. August 7th: 8:00 a.m. - 4:30 p.m.

The Oregon School Boards Association will demonstrate the use of Oregon's Education Computer Information Network (ORE-NET). ORE-NET's database is a resource for both classroom and school management applications. ORE-NET will have new menus and will be available at a reduced price for 1987 - 1988.

University of Oregon Information Online Service

University of Oregon Main Library
Information Online
Eugene, OR 97403
(503) 686-3053

August 6th: 11:00 a.m. - 5:30 p.m.

The University of Oregon Information Online Service provides computerized, customized literature searches for the U of O students, staff, faculty, and members of the community. With access to more than 300 databases such as BRS, ERIC and DIALOG, librarians perform searches in most subject areas. This service is available for a fee in the Main Library, the Science Library, and the Architecture and Allied Arts Library.

WISTEC (Willamette Science and Technology Center)

2300 Centennial Blvd.
Eugene, OR 97401
(503) 687-3619

August 6th: 11:00 a.m. - 5:30 p.m. August 7th: 8:00 a.m. - 4:30 p.m.

Fantavision, a magic motion and special effects generator, and *Flight Simulator II,* a flight simulator program of the Piper Cherokee Acher II, will be demonstrated by Frank Gornto of WISTEC. *Fantavision* is a movie making program. It allows you to design each frame and run it in sequence. The program will have a self-running demo disk with movies already completed, but demonstrations of the program itself will also be given. *Fire Organ,* a Random Graphics Generator that runs on the Apple IIe, will be shown on a request basis. Copies of *Fire Organ* can be made in the Software Review Lab.

Art Show

Erb Memorial Union - Art Gallery

August 2 - 15

Artists from the surrounding area will be displaying computer-generated and computer-related artwork. Artists include students in grades K-12 and U of O students, faculty, and employees. Take time to come look through the gallery and see what computers are creating and helping create today.

IBM Lab

Erb Memorial Union - Cedar E

August 6: 12:00 noon - 5:30 p.m.

The PC Network running from the manager PC Class will be available for questions and demonstrations. Many different kinds of educational software will be available for viewing, including software dealing with Language Arts, Sciences, Scientific Reasoning, and Mathematics.

Film and Video Review Lab Schedule

August 6, 7:30 a.m. - 5:30 p.m.

Erb Memorial Union - Ballroom

Thursday, August 6

7:30 a.m.	*Basic Communication Skills*
7:45	*Computers: The Friendly Invasion*
8:10	*Ethics in the Computer Age*
8:38	*The Alternate Reality Kit*
9:00	*The Computer and You - An Introduction*
9:20	*Sierpinski's Curve*
9:30	*Computers: The Inside Story*
9:55	*Designing a Life (Robotics)*
10:15	*Futurework*
10:40	*Careers in Math and Science: A Different View*
11:05	*Soaring through Knowledge Space: SemNet 2.1*
11:25	*Space: The Path to the Future*
12:00 - 1:00 p.m.	**Request Time**
1:00	*Computers: Tools for People*
1:30	*Dragon Fold . . . And Other Ways To Fill Space*
1:43	*Living With Change*
1:58	*Computers: The Truth of the Matter*
2:18	*Mandelbrot Set Animation #3*
2:25	*Mr. Microchip, Episode 9, Music on Key*
3:00	*Electronic Delinquents*
3:17	*Turning a Sphere Inside Out*
3:45	*The Computer and You - The Program*
4:05	*Computer Security*
4:30 - 5:30	**Request Time**

Film and Video Review Lab Schedule

August 7, 7:30 a.m. - 4:30 p.m.

Erb Memorial Union - Ballroom

Friday, August 7

7:30 a.m.	*The Information Lens*
7:50	*Using Databases*
8:15	*Living With Computers*
8:30	*The Numerical Aerodynamics Simulator*
8:50	*Supposer in the Classroom*
9:15	*A Long Ray's Journey into Light*
9:23	*Maps: From Quill to Computer*
9:55	*Factory Video*
10:45	*The Computer and You - The Program*
11:07	*Computers: Tools for People*
11:35	*Designing a Life (Robotics)*
11:55	*Turning a Sphere Inside Out*
12:25 - 1:30 p.m.	**Request Time**
1:30	*Mr. Microchip, Episode 9, Music on Key*
2:05	*Mandelbrot Set Animation #3*
2:13	*Space: The Path to the Future*
2:45	*Computers: The Friendly Invasion*
3:10	*A Long Ray's Journey into Light*
3:18	*Living With Change*
3:30 - 4:30	**Request Time**

Film and Video Review Lab

Descriptions

The Alternate Reality Kit: A kit for assembling physical microworlds. 16 minutes, 1/2" video.
Dr. Randall Smith, Xerox PARC, c/o Dr. Christopher Dede, University of Houston--Clear Lake, 2700 Bay Area Blvd., Houston, TX 77058. (713) 488-9494.

Basic Communication Skills: Students learn along with Elmer that communication skills - reading, writing, listening and speaking - are as important as ever in the computer age. 10 minutes, 1/2" video.
Age: Intermediate
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Careers in Math and Science: A Different View: Young men and women in a variety of interesting careers discuss requirements of their jobs. Help teachers answer: Why do I need to study this? 19 minutes, 1/2" video.
Age: Intermediate, Junior High School
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Computer Security: Points out that those who work with computer systems have an obligation to preserve the integrity of the information that is stored. 22 minutes, 1/2" video.
Age: College and Adult
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

The Computer & You - An Introduction: A primer for computer operations, the basic computer terms come to life by watching a student develop a project about the states of the US and provinces of Canada. 16 minutes, 16mm film.
Age: Intermediate through Junior High
Handel Film Corp., 8730 Sunset Blvd., W Hollywood, CA 90069. (213) 657-8990.

The Computer & You - The Program: The creation of a very simple airline program is used to explain the techniques of programming. 17 minutes, 16mm film.
Age: Junior High through Adult
Handel Film Corp., 8730 Sunset Blvd., W. Hollywood, CA 90069. (213) 657-8990.

Computers: The Friendly Invasion: Dazzling computer applications -- how computers work, tasks they can perform, opportunities they offer. 20 minutes, 1/2" video.
Age: Intermediate, Junior and Senior High School
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Computers: The Inside Story: In non-mechanical terms, explains the main parts of a computer, what each part does, and how they work together. Shows paths, gates, and signal patterns. 21 minutes, 16 mm film.
Age: College and Adult
Churchill Films, 662 N. Robertson Blvd., Los Angeles, CA 90069. (213) 657-5110.

Computers: Tools for People: Shows how computers are used in many ways: file management, control of other machines, support of creative work, and mathematic tasks including modeling. Demonstrates how applications are developed through research, flowcharting, programming and debugging. Emphasizes the human responsibility for computer performance and the excitement of people creating their own tools. 24 minutes, 16mm film.
Age: Intermediate through Senior High School
Churchill Films, 662 N. Robertson Blvd., Los Angeles, CA 90069. (213) 657-5110.

Computers: The Truth of the Matter: Lighthearted, positive introduction to computers -- basics. 15 minutes, 1/2" video.
Age: Intermediate and Junior High School
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Designing a Life (Robotics): Shows how robots are designed, built, and programmed for a specific task. 15 minutes, 16mm film.
Age: Grades 6 through 12
Lane ESD Media Library, P.O. Box 2680, Eugene, OR 97402. (503) 689-6500.

Dragon Fold . . . And Other Ways To Fill Space: The concept of a single closed curve which is the locus of a point that touches every point in a unit area is shown in the Dragon Fold curve and in the Sierpinski curve. 8 minutes, 16mm film.
Age: Junior High, High School and College
International Film Bureau Inc., 322 S. Michigan Ave., Chicago, IL 60604. (312) 427-4545.

Electronic Delinquents: Examines recent crimes executed by computer whiz kids. 12 minutes, 1/2" video.
Age: Junior High, High School, College, Adult
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Ethics in the Computer Age: Two mini-dramas deal with issues of software piracy and the altered information of a medical data bank. 23 minutes, 1/2" video.
Age: Junior and Senior High School
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Factory Video: Problem-solving, working backwards, and math. 45 minutes, 3/4" video.
Age: Junior High through Adult
Sunburst, 39 Washington Ave., Pleasantville, NY 10570. (914) 769-5030.

Futurework: "Futurework" incorporates humorous dialogue, catchy songs, and dance routines to introduce students to the changing nature of the workplace. Use this film to motivate students to consider new careers, focusing on fields that employ new communications systems, computers, and other new technology. 21 minutes, 3/4" video.
Age: Junior and Senior High School
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

The Information Lens: An intelligent system for viewing electronic messages. 15 minutes, 1/2" video.
Dr. Tom Malone, Sloan School, MIT, c/o Dr. Christopher Dede, University of Houston--Clear Lake, 2700 Bay Area Blvd., Houston, TX 77058. (713) 488-9494.

Living With Change: Student actors dramatize for Elmer that even such inventions as the telephone and automobile originally met with skepticism. As Elmer watches, he realizes that change can mean advances and benefits for society, and he decides to prepare for the future rather than fearing it. 10 minutes, 3/4" video.
Age: Intermediate
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Living With Computers: Introduction to computer applications in classrooms, homes, and businesses. 10 minutes, 1/2" video.
Age: Intermediate
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

A Long Ray's Journey into Light: A demonstration of ray tracing representing 50,000 CPU hours (5 years). Actually done using idle time from 200 Apollos networked together. 3 minutes, 1/2" video.
Age: Post-Secondary
c/o Continuation Center, Attn: Sandi Leavitt, 1553 Moss Street, Eugene, OR 97403. (503) 686-3537.

Maps: From Quill to Computer: History of maps from ancient to modern times; from cartographers' imagination to totally computerized data. 26 minutes, 1/2" video.
Age: Grades 9 through 12
Lane ESD Media Library, P.O. Box 2680, Eugene, OR 97402. (503) 689-6500.

Mandelbrot Set Animation #3: Partial exploration of the Fractal Landscape in Mandelbrot's set. 3 minutes, 1/2" video.
Age: Senior High School through Adult
Fine and Applied Arts Dept., University of Oregon, 230 Lawrence Hall, Eugene, OR 97403. (503) 686-3610.

Mr. Microchip, Episode 9, Music on Key: Discusses computer use to teach or make music and demonstrates complex keyboards. 30 minutes, 1/2" video.
Age: Grades 4 through 7
Lane ESD Media Library, P.O. Box 2680, Eugene, OR 97402. (503) 689-6500.

The Numerical Aerodynamics Simulator: Describes capability of NASA Research Facility. 15 minutes, 1/2" video.
Age: General
NASA/AMCS Research Center, Educational Programs Office, Moffett Field, CA 94035. (415) 694-5543.

Sierpinski's Curve: Provides proof that Sierpinski's limit curve actually passes through every point in the square. 5 minutes, 16mm film.
Age: College
International Film Bureau Inc., 322 S. Michigan Ave., Chicago, IL 60604. (312) 427-4545.

Soaring Through Knowledge Space: SemNet 2.1: A 3-D graphics tool for exploring hypermedia networks. 14 minutes, 1/2" video.
Dr. Kim Fairchild, MCC, c/o Dr. Christopher Dede, University of Houston--Clear Lake, 2700 Bay Area Blvd., Houston, TX 77058. (713) 488-9494.

Space: The Path to the Future: This film traces America's progress during the first 25 years of space exploration. Since the formation of the National Aeronautics and Space Administration (NASA) during the Eisenhower Administration, research and discoveries have had a dramatic impact on the quality of life on earth. All the wonder, mystery, and spectacle of America's successes, as well as some tragic failures, are chronicled. NASA film includes exciting footage of Mercury, Gemini, Apollo and Saturn missions. Students will become aware of the tremendous potential of scientific research in space and of some of the effects of the Space Age in their daily lives. 28 minutes, 1/2" video.
Age: Junior and Senior High School
CORONET/MTI Film & Video, 108 Wilmot Road, Deerfield, CA 60015. (800) 621-2131.

Supposer in the Classroom: Geometry. 20 minutes, 3/4" video.
Age: Junior High through Adult
Sunburst, 39 Washington Ave., Pleasantville, NY 10570. (914) 769-5030.

Turning A Sphere Inside Out: Discusses the problem of turning a sphere inside out by passing the surface through itself without making any holes or creases. 23 minutes, 16mm film.
Age: College
International Film Bureau Inc., 322 S. Michigan Ave., Chicago, IL 60604. (312) 427-4545.

Using Databases: Database information. 21 minutes, 3/4" video.
Age: Junior High through Adult
Sunburst, 39 Washington Ave., Pleasantville, NY 10570. (914) 769-5030.

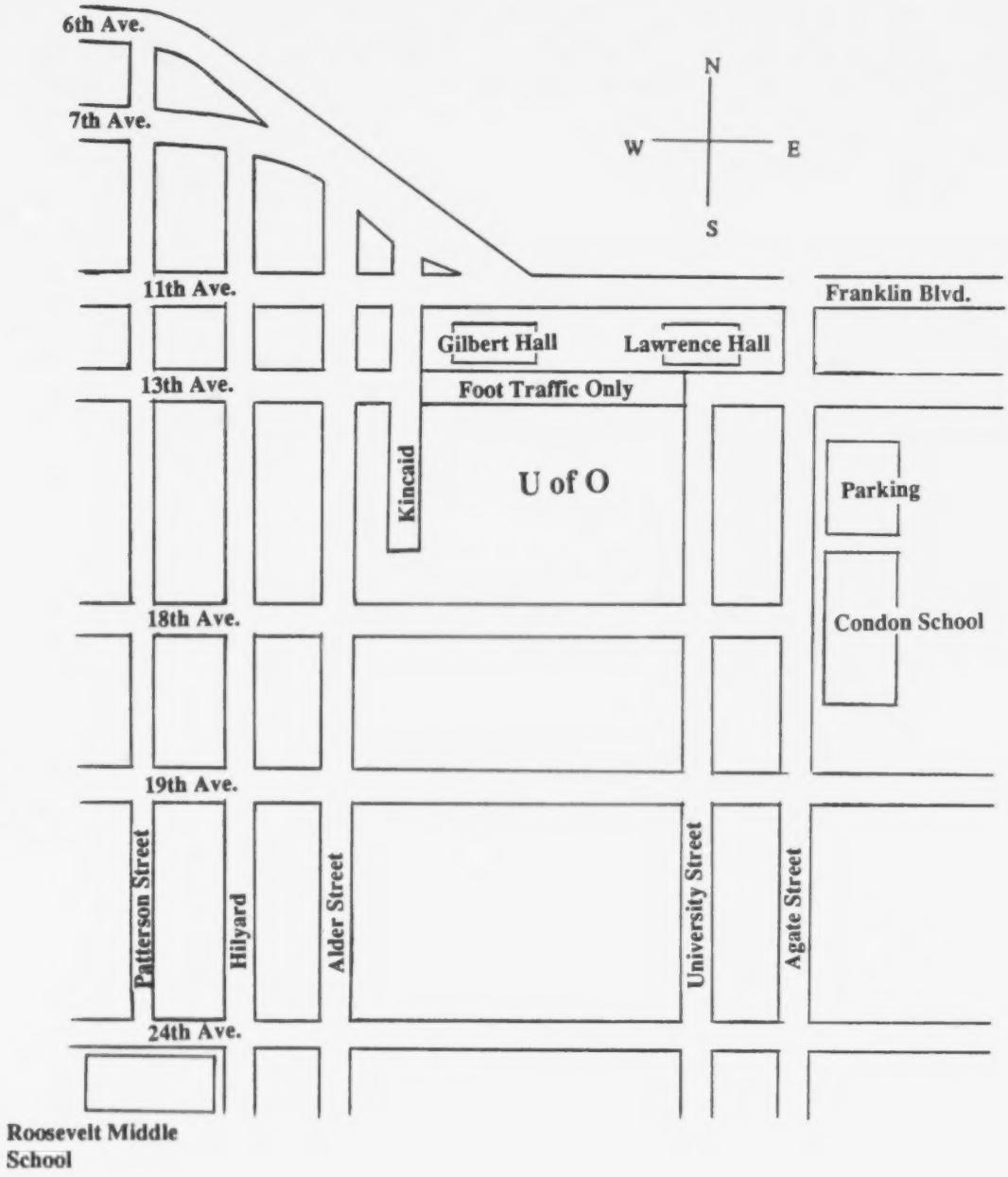
Postconference Workshops

Schedule and Locations

Workshop	Instructor	Time Saturday/Sunday		Location	Room
Advanced AppleWorks	Rathje	9 - 4 pm	10 - 5 pm	Condon School	124
Beginning AppleWorks	Mullin	9 - 4 pm	10 - 5 pm	Condon School	129
Introduction to Microsoft Works for the Macintosh	Wetzel	9 - 4 pm	10 - 5 pm	Condon School	127
Introduction to LOGO Using LogoWriter in K-12	Newsom	9 - 4 pm	10 - 5 pm	Colin Kelly Middle School	24
Apple Repair Anyone Can Do	Gustavson	9 - 4 pm	NA	Colin Kelly Middle School	22
Keyboard Success	Fidanque	9 - 4 pm	10 - 5 pm	Roosevelt Middle School	C2
Computers in Science / Voyage of the Mimi	Rankin	NA	10 - 5 pm	Colin Kelly Middle School	22
Using Page Layout Skills in the Schools	Lichty	9 - 4 pm	NA	Lawrence Hall	210
Problem Solving Across the Curriculum	Moursund	9 - 4 pm	NA	Gilbert Hall	138
Long-range Planning for Computers in Schools	Ricketts	NA	10 - 5 pm	Gilbert Hall	138

Postconference Workshop

Area Map



Note: Sign up for car pooling at the registration tables on August 6th and 7th. We would appreciate it if those people who can drive out to the postconference workshops, would let us know and we can connect others who need to go to the same workshop with you.

Colin Kelly Middle School

Map and Directions

Starting on the corner of 15th and University, turn left onto University.

Turn right on 18th Ave.

Turn right on Hilyard and move into the left hand lane.

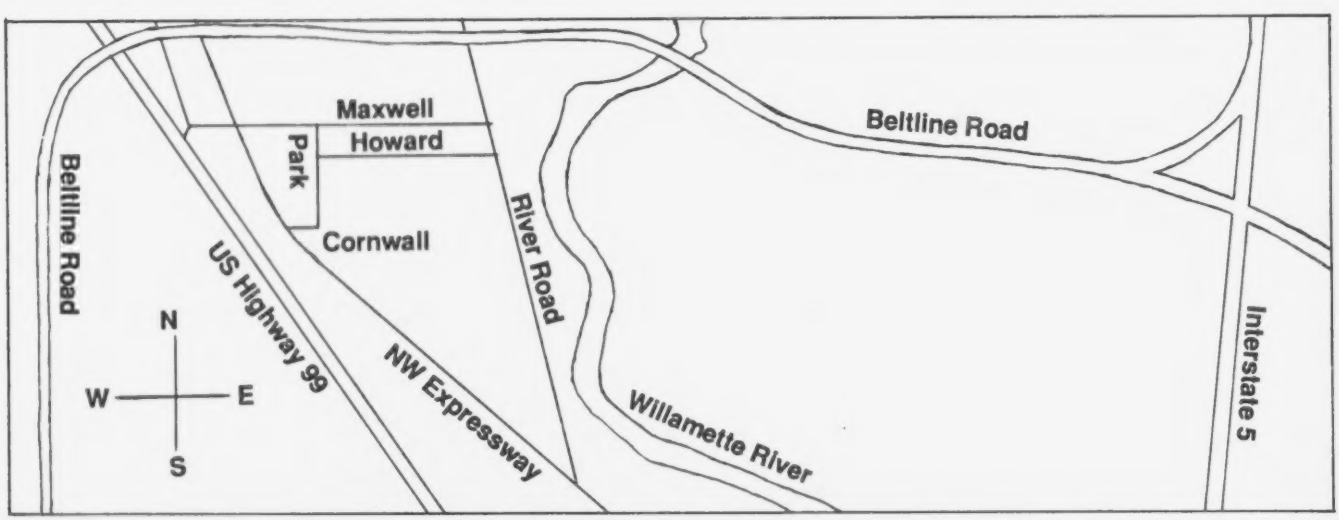
Turn left on 11th Ave. and move into the right hand lane.

Turn right on Washinton Street.

Turn left on 1st Ave. This road will become River Road. Stay on it.

Turn left on Howard Ave.

Colin Kelly Middle School will be on your left before the street turns into Park Ave.



Proceedings

"Extending the Human Mind: Computers in Education"

Sixth Annual Summer Computer Conference

Sponsored by

Center for Advanced Technology in Education

and

Continuation Center

University of Oregon

Held at the

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About CATE

and the

Continuation Center

The Center for Advanced Technology in Education (CATE) is a consortium of university-based, community and state organizations with an interest in the use of advanced technology in schools. The educational use of computers is a primary focus of the Center's activities.

Opened in the fall of 1983, CATE is the site of both pre-service and in-service training for educators and a field-based research and development program investigating a variety of advanced and interactive instructional technologies and their implications.

Members of the CATE Council and the CATE network are widely scattered across Oregon. They include school districts, state colleges, community colleges, extension services and the State Department of Education. Housed in the CATE facility at 1787 Agate Street is the ERIC (Educational Resources Information Center) Clearinghouse on Educational Management, the International Council for Computers in Education (ICCE), the Instructional Technology (IT) Laboratories, and the Career Information System (CIS). There is also a resource library and facilities for classes and workshops on the use of computers in education.

Leadership in fulfilling the University's outreach responsibilities rests with the University of Oregon Continuation Center, composed of the Community Education Program, Summer Session and Continuing Education. A primary goal of the Continuation Center is to promote educational programs which link research and knowledge in the University with interests and resources in the community. The programs, which include courses, workshops, specialized resources and conferences, must be contemporary and significant. Programs are provided at all levels, serving preschoolers to senior researchers, community professionals and non-professionals. The Continuation Center is concerned with broad-based, pervasive educational issues of our time. Few topics fit this concern so clearly as the Annual Summer Conference "Extending the Human Mind: Computers in Education."

For more information about CATE or the Continuation Center, write to Center for Advanced Technology in Education, 1787 Agate Street, Eugene, Oregon 97403, or the Continuation Center, 1553 Moss Street, University of Oregon, Eugene, Oregon 97403.

About The Proceedings

The Sponsors of the Sixth Annual Summer Conference "Extending the Human Mind: Computers in Education," the Center for Advanced Technology in Education (CATE) and the University of Oregon Continuation Center, are pleased to offer these proceedings.

Conference presenters deserve appreciation for their promptness in meeting deadlines so the proceedings could become a reality. To meet publication deadlines and control printing costs, the papers are presented exactly as they were received.

The authors of these papers were invited to make presentations at this Conference because of their acknowledged scholarly or professional competence in some aspect of computers and education. The findings, views or opinions expressed by those authors are entirely their own and do not necessarily represent those of CATE, the Continuation Center or the University of Oregon.

Additional copies of the proceedings may be obtained by sending $15.00 (prepaid or purchase order) to: Proceedings, Center for Advanced Technology in Education, 1787 Agate Street, University of Oregon, Eugene, Oregon 97403. Checks should be made payable to CATE.

Preface

This is the Sixth Summer Conference in this series sponsored by the University of Oregon. Understanding and using wisely the advanced technology now becoming available to us is a challenge worthy of any educator. We at the University of Oregon are pleased to contribute to that understanding and appropriate use.

The Conference is sponsored this year by the Center for Advanced Technology in Education, established by the Oregon State Board of Higher Education, and by the University of Oregon Continuation Center.

Primary roles in the organization of this Conference are played by Sandi Leavitt, Conference Manager, and Keith Wetzel, Program Chair.

The Program Committee also consists of Anita Best, Paul Katz, Bruce McKinlay, Dave Moursund, Cathy Murray, and Jack Turner.

LEARNER-BASED TOOLS FOR SPECIAL POPULATIONS

Barbara Allen

Prehistoric man no doubt sat in rapture as he contemplated the wonders of his first tool. A few "ages" later, we in the Information Age sit in similar wonder while our sight is transfixed upon a square tube and our fingers are cast upon a board of buttons. Mr. and Ms. Caveperson were unable to enjoy today's lifestyles, however we share in common a desire to find something which increases the quality and quantity of both work and play.

Reaching less further into our past, we might find Thomas Jefferson contemplating the future of his university. As brilliant as he was, it is doubtful that he was able to forecast the event that occurred there last year. Twenty special educators from across the United States and Canada were brought to a University of Virginia Institute to increase their knowledge about learner-based software tools. At the end of the three week seminar, the group returned to their homes lugging $5,000 worth of IBM donated software and hardware. To assure continued interaction with the conference leaders, (Glenn Bull and Paula Cochran of UVA and David Cartmell of IBM), the participants continued to communicate via electronic mail and conferencing.

In June of this year, the Institute members returned to the University of Virginia for a retooling, reunion and reformation. With IBM funding at a close, and with the desire to continue this rare experience---the group was reborn under a new name. The IBM/UVA Institute for Learner-based Tools in Special Education became the Special Talk Consortium. Our primary goals still encompass the development and field testing of tool applications, information dissemination, and networking of professionals for the exchange of information.

Because of the synergy I've enjoyed as a member of the Special Talk Consortium, I find it impossible to discuss my ideas about learner-based tools without touching upon the varied applications and software developments which my peers have shared with me.

With the above background information, let's delve more deeply into what this "tool stuff" seems to be.

What is a Learner-Based Tool?

Future archeologists will find it a greater challenge to describe this tool than today's archeologists who describe the ax. A 5 1/4" piece of plastic encased in plastic simply doesn't describe the abstract qualities of such an object. At this time

we can only describe what learner-based tools can do---yet that, too, varies widely according to the users' desires.

David Cartmell wrote of learner-based tools and the philosophy of their use. In summary, he presented the idea that people learn best when they are in charge of the learning process and can acquire knowledge at their own pace and under their own control. The teacher's role is to create an environment for the student, as well as to facilitate and encourage the learner. The learner-based tool is a combination hardware and software computer system which is open-ended. It can be modified, adapted and refined to fit the user and the task to which it is being applied. Examples of such tools which have been found particularly useful with special populations are: talking word processors, LOGO, data bases, switches, software using the CLOZE procedure, and videodisc players.

The Tools and their Applications

First, a general description of the tools will be given. Following will be examples of specific uses. Because of the wide variety of special populations, it is impossible within the space restraints of this paper to cover all areas. Hopefully, the reader will find ways to adapt these applications to specific student/client populations.

Talking Word Processors

The software used by the Consortium is IBM's "Listen to Learn" developed by Rosegrant and Cooper. They has worked with Scholastic to produce "Talking Text Writer" for the Apple. An IBM compatible version will be available in the fall. Other talking word processors are "Word Talk" (IBM/Apple) and Kid-Talk (Macintosh).

Description: "Listen to Learn" is a very simple word processor when compared to that used by most adults. That simplicity is just part of the good news when you begin using it with special populations. Additional features include text and background color choices (13 combinations), printer type-size (primary and elite), speech - typing mode (for each letter and word, word, or none), speech - reading mode (for each word, line or page), phonetic and phonemic editing, and dictionary (writer defines a word which can be called up later). As the words are read, the cursor highlights each word. Scholastic's versions can be 20, 40 or 80 columns in width, can print large text, and can vary the rate of speech. The software by Scholastic includes a sizeable teacher's guide by which is based upon the years of research while the software was being developed. The voice synthesizer is the ECHO PC by Street Electronics Corporation. Whatever hardware configuration you choose, make sure the system has earphone capability. Earphones will avert possible insanity when the teacher/clinician is subject to myriads of single letter

sounds, or when several computers are being used at the same time.

Applications: Were one to consider this software through the aspect of learning modalities, one can see immediately its richness. The learner interacts through body movement, vision and hearing. Psychologically, the learner feels he/she has control and through that control comes an incredible amount of involvement. Giving the learner control does not mean that the teacher loses control. The teacher sets the environment and often participates as the learning evolves. The software becomes teacher-based as well as learner-based. Here are a few examples of successful applications:

> Pre-reading/writing development can be targeted by writing a daily class newspaper. At the beginning of the day, the teacher asks for news items. The teacher records the news on the talking word processor. When the teacher targets certain graphemes, speech sounds or parts of speech, the children take turns pressing the appropriate keys. For instance, if the sound/grapheme of the day is "b", Johnny will press the "b" in the word "boy". If Suzie has difficulty remembering to put "is" in her sentences, she will input "is" during the recording of "Suzie is going to the store after school." The children can "read" and listen to the newspaper throughout the day. Hot news flashes could be incorporated as they occur. The news can be printed and kept in a diary or posted in calendar form. It's a great way to teach the concepts of "yesterday" and "last week".
>
> Written expression for developmentally delayed adults has also been targeted using talking word processing. Nick Lape, of the Southside Virginia Training Center in Petersburg, Virginia used Listen to Learn with Randy, a 29 year old resident in their program. Randy used a PCJr and Listen to Learn to "orally" present a prepared statement to his ID Team at his annual staffing. Nick wrote in his report, "Though Randy can hear and uses a combination of signs, gestures and writing to get across simple ideas, he had never before been able to present such an extensive description of his thoughts on what his training package should be like; what kinds of work he would like to do and where he would like to live. In addition, his presentation seemed to give Team members a different perspective on what Randy could do and not do, and most importantly, it caused them to talk with him at his staffing rather than talking at or around him." Portions of his presentation, including errors, are as follows: "I am 29 years. name randy. not talk. I sign good. sometime fall down. My brother lives in Petersburg. I fat 194 pounds. Some time "drool." My good friends are Malcon and Alvin. I want to live cottage 27. iwant key box. "room" with no one. (NOTE: Randy recently had surgery on his ankle) I not like "shot"sleep

"to" "cut foot" "Jacob Garris (died recently)" I sad and shock.sorry.aide not talk randy "death".Jacob my friend. Nick tell me."

Vocabulary skills can be increased using the dictionary feature. Other work in vocabulary may come as a part of the process of writing and editing. Using the technique of creating word lists prior to writing, the word processor records the lists. Definititions and/or synonyms are developed at that time. Both deductive and inductive thinking are part of the process. The students put their heads on their desks as another student selects the dictionary feature for a specific word. Then the class guesses the word which has been defined.

Articulation/Phonological processing skills can be worked on by creating word lists targeting the sound. The child enters a word of her choice and creates sentences for the word. She creates her own workbook by printing copies. Her work may be shared with her teachers, friends and/or parents by distributing reproductions of her work. Children with articulation disorders take great joy in correcting the speech of the computer through the phonetic change feature. It gives them solace to know that the computer "blows it" sometimes, too!

An excellent accessory tool to the talking word processors is the videodisc. With its unmatched capability to provide pictures (100,000 on a single disc), it is a ready reservoir of visual stimuli. The motion picture capability also presents excellent resources for narrative script. From writing the narration of King Kong sequences to describing mountains, the easily accessible pictures are a fantastic asset to the language process.

CLOZE formatted software

Description: "Missing Letters" by Carol Chomsky and Judah Schwartz is the only software I am familiar with which follows this format. The standard formats included are 1) print consonants only, omit vowels, 2) print first and last letters, 3) print every other letter, 4) print first letter of each word, 5) print vowels only, omit consonants, 5) print all blanks, 6) delete every second through eighth word. One can also create a custom format. For example, you may wish to delete all nouns or prepositions. Although many passages have been included in the software package, the power comes when you (or the students) add passages. A score for the task is calculated at the completion of each passage.

Applications: Chomsky and Swartz believe a particular virtue of the game is the indirect nature of the instruction it provides. In the program's documentation they state, "The game develops language 'skills' through players' interaction with

language and with each other in an interesting, engaging activity that is worth doing for its own sake. The puzzle-solving aspect of the game is its primary feature, and the varieties of educational merit derive from the thought, concentration, and feedback that occur during play." Among the several examples of applications they suggest are:

> Systematically replace occurence of a set of spelling words. Consider choosing several varieties of deletions: 1) all occurrences of specific letter combinations, 2) all occurrences of double letters, and 3) all letters of any word on the spelling list.
>
> Replace occurrences of a set of vocabulary words.
>
> For a memorization task, require students to work through the passage in a sequence of formats of increasing difficulty.

From my own experience, I have found this type of software to be helpful in working with children who have phonological processing problems. Besides being speech/language disordered, these children often are classified as learning disabled. Some of the environments I have created for these children are:

> Transcribe the child's reading text. During his free time, he reads through the passage using increasingly difficult formats. The child volunteered (demanded?!) to come to my room before school started to "play" with the computer.
>
> Have the child dictate a passage that he makes up. It could be as simple as describing last night's activities, or it could be a make-believe story. One of the children with whom I did this had serious emotional problems and was very resistant to speech intervention. With this particular child, all the vowels were removed for him to fill in. It was one of the very few structured speech tasks that he was willing to accomplish.

LOGO

<u>Description:</u> The LOGO language is used extensively by the Consortium. Many of the members have developed elaborate programs. Others use it while working with LOGO tools that were developed by the directors of the Consortium. It has been used with "switch" programs (input to computer is via an on/off switch) for orthopedically impaired learners. LOGO tools have been developed for the videodisc players which were donated by Philips to the Consortium. Although turtle graphics are not ignored, quite a bit of emphasis is placed on the list features of the language. Of course, synthesized and digitized speech is a much used feature.

Applications: Members of the Consortium vary greatly in their ability to program in LOGO. To the trained LOGOtician, the complexity of the programming involved may be readily apparent in the following examples. However, to most of us, the complexity is secondary. What is most important is the pragmatics---what can it do?! Here is a smattering of what members have developed:

ORDER - presents 15 sentences with the words in random order and asks the student to arrange the words correctly. (Nick Lape)

KABOOM - asks a student to move a turtle into a small target using Talking UVa.Instant (an "instant" LOGO language which utilizes synthesized speech). (Nick Lape)

GAB - switch activated conversation between two students. (Nick Lape)

VISUAL - operates with a single switch connected via an adapted joystick which presents a visual stimulus on the screen and gives the student a specific amount of time to respond by hitting the switch. (Carolyn Haykin)

JOYSING - operates with a joystick that moves the turtle to draw a wave form as the joystick is moved from right to left and back. The computer produces a tone that is associated with the position of the turtle. When the joystick is held all the way to the left, the pitch is low. As the stick is moved to the right, the pitch gets higher. (Carolyn Haykin)

DRAW OBJECT - contains all procedures necessary to draw a train, truck, boat, snowman or a house. Each object contains at least five distinct parts. All the objects can be colored or made bigger or smaller. Parts of objects can be erased, made to "blink" or drawn in different colors. (Dave Matt)

KALAIDOSCOPE - through switch input, will draw colorful kalaidoscope renderings. (Betsy Calvert and Cheryl Wissick)

LIST MAKER - generates, stores and allows interactive use of vocabulary items. (Dave Matt)

SHOP TALK - uses a computer controlled slide projector, and digitized sound to teach motorcycle engine repair. (John Hall)

WARM FUZZY - must spell word correctly before "warm fuzzy" graphic appears. Graphics are made by older children using LOGO. (Rachel Miller)

A Few Words of Advice

Although the issue of control has been mentioned only briefly, it plays an important role in any learner-based software tool. A fellow Consortium member told us of his chagrin when he realized that his students started to hate coming to class. They dreaded working with the computer. In his enthusiasm to use the computer, he was unwilling to share control of the computer with his students. When he discovered his error, the children immediately became enthusiastic. Many teachers who begin to use learner-based software tools have learned the "control" lesson the hard way. Be aware of this issue, and explore it as you acquire skills in using these tools.

Resources

Kidtalk - Macintosh
First Byte
2845 Temple Avenue
Long Beach, CA 90806

Listen to Learn - IBM
Rosegrant and Cooper
IBM Corporation
P.O. Box 1328-W
Boca Raton, FL 33429

Talking Text Writer - Apple (and soon IBM)
Rosegrant and Cooper
Scholastic, Inc.
New York, NY 10003

Word Talk - Apple
Word Talk - IBM
Grimm and Miller
Computer Aids Corporation
124 West Washington, Lower Arcade
Fort Wayne, Indiana 46802

Echo PC, Echo GP, Echo+
Street Electronics
1140 Mark Avenue
Carpinteria, CA 93013

Votrax Personal Speech System
Votrax
1394 Rankin
Troy, MI 48083

MICROS AND MAINFRAMES: PRACTICAL ADMINISTRATIVE APPLICATIONS AT THE BUILDING LEVEL

Jeannine Bertrand and Eric Schiff

The intent of our seminar is to demonstrate and discuss some of the more effective means for utilizing computer technology in administrative management. While the primary focus of uses in our talk is aimed at the building level, attention will be given to the involvement and commitment of implementing technologies district-wide. The opportunities for integrating computer applications in the daily functioning of an educational institution run the gambit from generating weekly calendars with "clip art" graphics to full blown student services systems which provide on-line scheduling, attendance and records. We've chosen to highlight programs and applications which have successfully benefitted a variety of personnel and building operations.

Microcomputer Applications

Microcomputers are still the mainstay for administrative computing in a majority of school districts regardless of size. While many districts access local or regional ESDs for data processing, the bulk of the day-to-day information processing most likely takes place on a micro system. Depending on a schools size (and the need/amount of inner-district communication), employing micros can be very effective.

Simple To Complex Uses

The adage, memory is everything, certainly is appropriate when talking about the level of application one chooses for accomplishing specific tasks. Base memory capacities for micros range from 128k to 1 megabyte. Add hard disks (10 or 20 megabytes), and one can create a very powerful system capable of a myriad of complex applications. Regardless of system brands, most are supported by a variety of well designed integrated and task specific software.

Word processing. Depending on the memory available, and to an extent, the system; one can get by with an adequate program or cruise with powerglide options such as built-in spell checkers, graphic insert and hyphenation capabilities. Examples of programs include: Appleworks, WordPerfect, Microsoft Works, and Microsoft Word 3.0.

Data base operations. Again, memory size is directly proportionate to the complexness of solving or defining parameters for organizing data. In some cases and depending on the software being used, data bases may be better defined in a spreadsheet format. Examples of data base programs include: Appleworks, dBase III, Microsoft Works, and Jazz.

Spreadsheet operations. Here too, memory will determine the approach to solving a problem using a spreadsheet format. Simple operations such as logging student fees, lunch money accounting, etc... are basic; projecting school-wide yearly budgets may provide a level of complexity that a more powerful program can better address. Examples of Spreadsheet programs include: Appleworks, Microsoft Works, Lotus 1-2-3, Excel and Jazz.

Utility programs. Utility programs can be defined as those which are task specific to generating products somewhat limited in scope but can be applied relatively quickly and with ease of use. Posters, signs, banners, calendars and certificates can be created on demand and look pretty slick when printed (which can be enhanced by xeroxing on a variety of quality colors and parchments). Examples of utility programs include: Print Shop, Print Shop Companion and Certificate Maker.

Desktop publishing/productivity: With the advent of quality productivity tools, program developers have made publishing documents an art form. Given some basic training, practice and a little creativity, one can now produce newsletters, cover designs (replete with detailed graphic designs and multiple fonts and styles), magazines, and yearbooks. Wow! Examples of programs include: News Room (not easy but little memory required) and PageMaker.

Student service programs: Micros are capable of running fairly complete student service packages given enough

memory. A stand alone system that can handle student scheduling, attendance, records and have auto-dial and scan capabilities is quite impressive. An example of a student service package for micros is the Columbia software package.

Mainframe Applications

Many larger school districts and some state-wide programs which have implemented very powerful centralized Mainframe computer systems as means for addressing their information processing needs are now realizing the benefits that previously were held primarily by large corporations or state higher educational institutions. The ability to share information quickly and efficiently through networking and accessing central or regional data banks holds wide ranging implications. Perhaps the most obvious example of the effectiveness of such systems is the amount of time and paperwork that is cut from daily operations. Information can be communicated directly from the central office to buildings, building to building and within buildings (those having multiple terminals) in a matter of seconds. The possibilities for applications are extensive. Some have been tried and proven effective while many are currently being field tested and refined. The Eugene school district has implemented a very comprehensive and expanding computer information system using Digital equipment. The examples of applications demonstrated and discussed specifically reference Digital equipment and Digital VAX based software.

Desktop Work Stations In The Public Schools

The day of seeing building and district administrators, along with their support staff, with terminals on their desks is fast becoming a reality. After all, why should efficiency in the work place be limited to corporate arenas? It shouldn't be, and with foresight and careful planning by well directed committees, school districts are keeping in step with the information age. In Eugene schools, all administrators have desktop work stations along with head secretaries and other support staff. As the benefits of these systems have been realized, the central offices and individual buildings have budgeted monies to add additional terminals. In part this is to support a broader network within the district offices and at the

building level, but it also reflects the "new" applications that range from teacher/student access for instruction to library automation. In our talk we will highlight uses of the Digital VAX system which we are currently employing and those soon to be in place.

Jefferson Middle School: A building-wide implementation model. When it became evident that the Eugene school district was moving full speed ahead with implementing a district-wide, fully networked information system, we redefined some budget priorities and purchased five terminals in addition to the two provided to middle schools by the district. We also purchased a laser printer. The high-speed lines, multiplexer and wiring was covered by district which was a definite sign of support for our coming on-line with such commitment. As part of a multi-year phase-in, all schools will be receiving additional terminals from the district in 1987-88. For Jefferson, that means a total of nine terminals and a laser printer for a school serving a population of approximately 400 students. This figure does not include the dial-up micro access currently available from the instructional computer lab. The in-building networking potentials are just beginning to be realized.

The purpose behind our building-wide automation is to support the middle school concept in place there. The three grade levels have team leaders who are responsible for some administrative duties including student scheduling, managing team budgets and ordering team supplies. All of these functions, as well as daily communiques with the principal, assistant principal, counselors, secretaries and each other, can be effectively carried out on the VAX system. Communication between all of these factions has been greatly enhanced through use of the network.

The All-in-One umbrella. One of the beauties of working with the VAX system is the ability to work simultaneously with a variety of applications in VAX All-in-One. As talked about earlier, saving time and paperwork has been a direct benefit using the VAX.. E-mail (electronic mail) does just that by providing electronic messaging to anyone holding a user account or to specific user distribution lists. For communication within buildings and certainly district-wide, considerable time and duplication of effort is saved through the use of E-mail. Another communication application frequently used is the

terminal phone - teleconferencing with other users as the need arises.

The word processing application is powerful and with quick access to a spell checker (actually from most applications) and the user's personal dictionary make it complete. Data base and spreadsheet applications are also available in the All-in-One and reports can be generated to integrate the different applications.

A feature that has been a life saver for administrators and team leaders at Jefferson has been an application found in the time management menu of All-in-One. Calendars and personal appointment schedules can be generated and kept for easy access. An additional feature is available which allows limited access by other designated users to view someone else's schedule.

Specialized applications: While the All-in-One provides a wide variety of applications, specialized programs have been developed by our school district programmers. A program example is the on-line warehouse ordering. Accounts are assessed and goods identified as available or out of stock while the user is on-line.

Commercial programs that provide more complete and/or powerful applications than those contained in All-in-One can also be put on the VAX system. An example of a very powerful data base/spreadsheet program is 20/20. Recently, after an almost two year committee search, Eugene schools purchased a complete student services system from Sierra Software company. As schools are phased in, all information processing regarding students can be done on-line with the ability to share information on the network district-wide. On-line scheduling, creating master schedules, generating courses, attendance, student records and a myriad of report generating capabilities will greatly benefit administration, staff and students.

Micro and Mainframe interface. With well developed software and the appropriate interfacing (modems, ports, cables, etc...), hanging a micro off of a Mainframe is not only possible but can be done rather easily and, for some purposes, afford a more viable means having the best of both worlds. Apples and VAX are very compatible. Once corresponding keystrokes to give standard terminal functions are learned, an Apple II series or a

Macintosh system works like a charm accessing the Mainframe. The more powerful and smoother interfacing programs are available and being developed for the Macintosh. Files from both the Apple II series and the Macintosh can be up-loaded into the VAX where they can be stored, edited and printed. As teachers and administrators become more familiar with the micro/VAX connection, one may see computer labs, departments and specialized programs (special education) taking advantage of the connectivity to access the wealth of information residing on the Mainframe while retaining the unique characteristics of ones micro system of choice.

Conclusion

For most school districts, the computer/information age hit hard and fast. Learning while doing was the norm and making systems and software purchasing mistakes was inevitable. As districts and individual schools identified application needs for both instruction and management, each group developed strategies quite independent of one another. While the tasks of both groups are certainly different from one another, many of the same processes for refining needs, means for implementing programs and expanding applications in areas that overlapped curriculum and management, have become evident.

Information and resource sharing between these two groups is essential in furthering development and effective uses of both micros and Mainframe in the public educational arena. The Eugene school district has begun to do this by opening communication between instructional computing coordinators and curriculum councils and the district (management) computer policy committee and the computer information services. The effects have been extremely rewarding for all parties involved with subcommittees formed to pursue a variety of new systems and program applications.

LOGO AND LOGOWRITER IN THE CURRICULUM

Billie H. Brown

Logo

For years now the Logo Language enthusiast has proclaimed along with its creator, Dr.Seymour Papert, that Logo promoted learning in and of itself. It stood alone apart from the curriculum as a valuable educational tool. The purpose of this paper, however, is not to make Logo stand alone but to demonstrate how wonderfully Logo and LogoWriter may be used to enhance the teaching in almost any curriculum area. Specific examples will be given, but many of the projects could be used in other subject areas, also.

Literature

A stacking story involves having one object or animal stack upon, against, or within another. A stacking story for small children is an especially good way of demonstrating how much the use of Logo illustrations alone can add to a short story or book. The first story my students video-taped, "La Hormiguita" is taken from a book of Mexican folk tales called The Day It Snowed Tortillas. The original pictures were programmed by a media specialist, Candy Colborn, in Englewood, Colorado to add new delight to an already favorite story of her groups of small children. "Oh's" and "Ah's" are plentiful when by the touch of one key on the computer the illustration of the story being read changes on a color monitor or on a large TV.

My students illustrated the old childrens' story "The Snake That Sneezed" by Robert Leydenfrost. Ten simple scenes were drawn in pencil on paper, lined, and marked to match the quadrant screen in Logo. Many of the same background elements and some of the characters were used in a number of scenes teaching cooperation. Terrapin Logo doesn't have a fill command, therefore, color was added to each picture by using the KaolaPad. Because so much memory had been used for the scenes, the students video-taped the story, timing each scene for a comfortable reading. They also added theme music to the two stories, written in Logo and played from another computer wired into the video. The middle school students enjoyed reading both of these stories along with showing this video to elementary children.

Language Arts

English. Mad Libs is a familiar game to all middle school students. To be played by one or more players, each Mad Lib is a story with certain words left out. Programmed in Logo, the students enjoy Mad Libs most in groups of two

or three or when meeting the challenge to write their own to try on each other. Learning the parts of speech is incidental to the game, but may be the teacher's goal.

Creative Writing. A young child will enjoy the variety of poems possible with the following program.

```
TO POEM
CLEARTEXT
PRINT [NAME A BOY]
MAKE "BOY REQUEST
PRINT [NAME A GIRL]
MAKE "GIRL REQUEST
PRINT [NAME A HIGH PLACE]
MAKE "PLACE REQUEST
PRINT [NAME SOMETHING TO CARRY THINGS IN]
MAKE "CARRIER REQUEST
PRINT [NAME A LIQUID]
MAKE "LIQUID REQUEST
PRINT [NAME A DIRECTION]
MAKE "DIRECTION REQUEST
PRINT [NAME A BODY PART]
MAKE "PART REQUEST
PRINT [NAME AN ACTION ING WORD]
MAKE "ACTION REQUEST
WAIT 30 CLEARTEXT
PRINT [HERE'S YOUR ORIGINAL POEM]
PRINT []
WAIT 50
PRINT (SE:BOY [AND]:GIRL)
PRINT SE [WENT UP A ]:PLACE
PRINT SE [TO GET A ]:CARRIER
PRINT SE [OF]:LIQUID
PRINT SE:BOY [FELL DOWN]
PRINT SE [AND BROKE HIS]:PART
PRINT (SE:[AND]:GIRL [CAME]:ACTION [AFTER HIM.])
```

Middle school students enjoy writing cinquain poems with the help of the computer. Logo students can add to the following procedures and help create many a cinquain poem.

```
TO CINQUAIN
INTRO
WAIT 500
POEM.]
WRITE
WAIT 400
POEM
WAIT 500
CLOSE
WAIT 500
END
```

```
TO INTRO
CLEARTEXT
PRINT [A CINQUAIN IS A FIVE-LINED
PRINT [HERE'S A CINQUAIN ABOUT ME:]
PRINT []
PRINT [COMPUTER]
PRINT [BUSY, FAST]
PRINT [FLASHING, COUNTING, TEACHING]
PRINT [LOVES TO WORK WITH CHILDREN]
PRINT [MACHINE]
PRINT []
END
```

```
TO CLOSE
CLEARTEXT
PRINT [A SPECIAL CINQUAIN ABOUT] :NOUN
PRINT []
PRINT []
PRINT :NOUN
PRINT :ADJECTIVE :ADJECTIVE2
PRINT :VERB :VERB2 :VERB3
PRINT :PHRASE
PRINT :NOUN2
PRINT []
PRINT []
PRINT []
PRINT [GREAT JOB!]
PRINT []
PRINT [] HOPE YOU WRITE A NEW POEM SOON.]
END
```

Can you write the two missing parts "TO WRITE" and "TO POEM"?

Music

With the help of a simple Logo music sheet giving pitch and duration numbers, students with little or no music background are able to write Logo programs for simple tunes. The music student soon begins to create his or her own tunes in Logo. At first, students are encouraged to experiment with a simple familiar tune such as the following:

```
TO TWINKLE          TO STAR1
 STAR1               PLAY [10 10 17 17 19 19 17]
 STAR2                    [40 40 40 40 40 40 90]
 STAR3              END
 STAR3
 STAR1
 STAR2
 END
```

Math

Negative/Positive Numbers for a math class in the lab will take three or four periods of activities before the students are programming on their own in Logo. A Logo class will require less time and less supervision. This lesson is introduced by the locating of various objects on a large quadrant chart, which is then related to the Logo coordinate system through activity sheets containing programs using SETXY commands. One program draws a plane who's propellor turns. Two games, TIC.TAC.TOE and GET.IN.SHAPE are then played using the coordinates before beginning the final assignment of drawing an original design or game on a grid and then programming it in Logo coordinates.

TIC.TAC.TOE Procedures

```
TO LINES
PU SETXY -30 100
PD SETXY -30 (-80)
PU SETXY 30 100
PD SEETXY 30 (-80)
PU SETXY -90 40
PD SETXY 90 40
PU SETXY -90 (-20)
PD SETXY 90 (-20)
PU SETXY 0 (-80)
END
```

```
TO X
 LT 45
 PD FD 20
 BK 40
 FD 20
 RT 90
 FD 20
 BK 40
 FD 20
 LT 45
 PU
 END
```

```
TO O
 PU
 FD 19
 LT 90
 PD
 CIRCLEL
 LT 90
 PU FD 19
 LT 180
 END
```

```
TO CIRCLEL
  REPEAT 36[FD 3 LT
20]
  END
```

Geometry

Tangrams is an excellent follow-up activity to Negative/Positive Numbers for either a math or Logo class. After a bit of Chinese history, students discover and discuss how the seven pieces relate to each other as they manipulate cut-outs. They then explore the Logo programs, noting the movement of the turtle and the effect of variables. Class members often progress slowly from putting two triangles together to make a square, to using seven pieces for a cat, to building a scene containing three Tangram objects of various shapes and sizes. Unless a class can write their own, the students use the following programs:

Logo Tangrams

```
TO TRI :A
FD :A RT 135
FD (:A*SQRT(2)) RT 135
FD :A RT 90
END

TO SM :A
TRI :A
END

TO MED :A
TRI (:A*SQRT(2))
END

TO LG :A
TRI (:A*2)
END
```

```
TO SQ :A
REPEAT 4[FD :A RT 90]
END

TO PAR :A
REPEAT 2[FD :A RT 45
FD :A*SQRT(2) RT 135]
END

TO PAR2 :A
REPEAT 2[FD :A RT 135
FD :A*SQRT(2) RT 45]
END
```

A little change in each will fill the polygon and make a solid picture of the seven parts.

LogoWriter

LogoWriter was designed under the direction of Dr. Seymour Papert of MIT, and combines the most recent improvements of the Logo language with a programmable word processor. This enables students to write Logo programs and put text on the same screen. Students can build a scrapbook of "pages" filled with text, graphics, music, and Logo procedures. Each student has a shape table (30 shapes) with some provided shapes and space for new creations.

LCSI offers LogoWriter through a site license package for the Apple, IBM PC or PC Jr., and the Commodore 64 which contains among other things six student project booklets and 100 activity cards. The ideas and suggestions are based on a project approach and can be used to enhance any curriculum area. LogoWriter is a tool for all subjects.

Language Arts

The following are some suggestions to help students get started in this curriculum area: illustrate a poem, write a story using animation, design a party invitation, add music to the text of a story, write a dynamic or branching story, or create an advertisement for a favorite store or product.

Special key commands have been added to the old Logo favorites for the use of the word processor. Highlight, cut, copy, paste, replace, and erase to the end of line are made easy.

Using the word processor the simple younger child's poem "Mary Had A Little Lamb" may appear in text on the screen. Much delight is added when in place of the words lamb, snow, and Mary a picture appears for each. It is even more impressive when Mary and the lamb come down screen from the text and walk away together at the end. Pictures add much; animation adds a great deal more.

Animation is quite easy in LogoWriter. A student can animate a single shape or multiple shapes; a design taken from the shape table or an individually created shape. Either of the following programming methods will animate a shape:

```
REPEAT 999[FORWARD 1 WAIT 1]
```

```
TO MOVE
FORWARD 1
WAIT 1
MOVE
END
```

Text and graphics print easily with LogoWriter. The command PRINTSCREEN prints both exactly as they appear on the screen. The text is printed in big letters. PRINTTEXT

prints just the text portion in normal size text characters. The page may be much more than shows on the screen. PRINTTEXT80 prints the text portion of the page in the 80 column mode.

Social Studies

Activities in this area might be to trace a map, fill or shade a map and add a key, create a bar graph, develop a dynamic "topical" page, or build timelines.

The Workspace is a blank page in LogoWriter with a Command section at the bottom. The Front Side is for non-procedural work and the Flip Side is for the program procedures. Using the turtle moves, a map may be traced on the Front Side and the states or countries labeled or numbered with the word processor. Then on the Flip Side of the page, procedures may be written to add a key, or to produce a quiz or game. Identifying pictures may be STAMPed, color FILLed in or music be added from the Flip Side.

To make music the command TONE is used followed by numbers for the pitch and time. For example, TONE 440 20 plays the A note for one second. A chart of pitch numbers is provided. Time is measured in 1/20th of a second, so 20 = 1 second, 40 = 2 seconds and so forth. Music may be used to add knowledge or just for fun.

Math

Using LogoWriter a math teacher or student may create an arithmetic worksheet, illustrate thought problems, explore polygons, experiment with tossing dice, or graph functions.

Bar graphs always come in handy. The following procedures help a student draw bar charts specifying the length, width and color.

```
TO BAR :LENGTH :WIDTH :COLOR
SETC :COLOR
REPEAT 2 [FORWARD :LENGTH
       RIGHT 90
       FORWARD :WIDTH
       RIGHT 90]
FILL.BAR
END
```

```
TO FILL.BAR
PU RIGHT 45
FORWARD 10 PD
FILL PU
BACK 10
LEFT 45 PD
END
```

Science

Science students may use LogoWriter to create a cover page for an assignment, experiment with dynamic turtles, explore planetary orbits, plot a graph of data, or explore and illustrate change of various kinds.

Change is more easily understood and appreciated when visually absorbed. A simulation of trees growing in windy spots or of fungi growth, death, and decay are possible through the use of the stamp, shape table, and animation.

The use of Logo and LogoWriter as a learning tool for the enrichment of any curriculum is limited primarily by the imagination of the teacher and students.

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The Computer as Construction Kit

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How can computers be used to for children to experiment with, as contexts in which children can create, vary, and test out ideas? The genre of construction kits provides an ideal focus for educators who are looking to the computer for interesting, appropriate educational contexts for experimentation. In this paper, I will explore some of the available software that provides children with the opportunities for experimentation. In the process, I will examine some of the advantages of the computer as a medium of experimentation as well as some of its limitations.

The framework on which this paper is built is based on two premises: (1) that computers should be used in ways that are compatible with one's educational goals, just as any other curriculum tool should be, and (2) that the purpose of computer use, particularly with young children, should be to extend experience in ways not possible in other media; specifically, by providing children with opportunities to control variables and information in order to engage in experimentation.

Many who work in computers and education ask questions about what it is possible for children to do or what they like to do with a computer. But in fact the starting point should be the question: How do children learn?

Children learn through theory-building. Constructing theories based on experience, they are engaged in constant efforts to understand the world. To do so, they hypothesize about relationships between their actions and the actions of objects or materials, they experiment on the world to test hypotheses, and they modify their hypotheses as a result of the effects observed. The key is experimentation.

One of the major ways that we as educators can facilitate theory-building, then, is to provide children with numerous contexts for experimentation. What are some existing computer contexts for doing that?

Generally, it can be said that while there are many programs available for young children, very few of them provide contexts for experimentation. Most of them present problems to children that have one correct answer. The function of the computer program is to give the child feedback as to whether he or she is right or wrong. Drill-and-practice software for young children is reflecting an educational goal of transmitting to the child information that the program possesses. There is no room, nor a need, for experimentation on the part of the child, because the child is not constructing any knowledge or exercising self-direction; rather, the educational context is one in which the child is the passive recipient of knowledge. Errors are corrected—that is, the child is given feedback on his or her

performance, feedback intended to change the child's behavior so that there will be a subsequent correct response.

Drill-and-practice software is based on certain premises as to what the goal of educational software should be, premises that are consistent with a behaviorist view of learning. As I stated earlier, software should be consistent with the goals that teachers are holding. If the goals of an early childhood classroom are to teach children to recite the alphabet or to count, then some of the drill-and-practice programs are no worse than flashcards and probably more interesting to children. But, and going back to the major topic of this paper, they are not providing a context for children to engage in experimentation, and therefore they are not consistent with a constructivist view of education.

Seeing the computer as a construction kit is consistent, however. I am defining a construction kit as a configurable computer micro-world which presents children with elements that can be selected and/or varied by the child, and usually they can be activated (animated or played with) in some way. The prototype of construction kit software is Bill Budge's Pinball Construction Set (Electronic Arts). In this very well-designed pinball game, the player can select a pre-made pinball game field and play it or can design one from scratch; can rearrange elements within the playing field, add and subtract elements such as flippers and bells; and can vary a wide range of influences on the way the game plays, such as the gravity within which the ball moves, the speed of the ball, etc. There are many possibilities, most of them with very visible and interesting effects on how the game plays. Thus, the game of pinball becomes an arena for experimentation with a number of different variables. There are other, similar, types of game construction sets, such as Maze Craze and Arcade Machine, which have many of the same features as pinball construction set. All of these games provide highly motivating contexts in which children can engage in the processes of experimentation.

These are programs designed for older children and adults, however. Using them as prototypes, let's now look at a few programs that can exemplify what construction kits could be like for young children.

A very simple program that facilitates experimentation is Facemaker (Spinnaker). In Facemaker, children can "play around" with variations in parts of a face, and then can animate their creations in a simple way. In a similar vein, Mask Parade (Springboard) allows children to create feet, glasses, and masks, with the added bonus of being able to print out the creations and use them.

Experimentation can be in different domains. In the area of experimenting with words and referents, Story Machine (Spinnaker) permits children to experiment with language, although children do need to be able to read the fairly limited dictionary of available words. They can creatively combine and vary different words and actions that are animated. Also in the language domain, Kermit's Electronic Storymaker (Simon and Schuster) gives pre-readers access to some elemental story-making by selection of parts of sentences using the

joystick button. Each sentence creates a frame which can be sequenced together. Probably more suitable as a context for experimenting with variations than as a creative story format, Kermit is an appealing program for young children, and does allow them to save, extend, and vary their creations.

Ranch (Spinnaker) is more of a "true" construction set designed for younger children. Using different "building" elements, both inanimate shapes and animatable pieces such as animals and trains, the child can construct a scene complete with a selected tempo of Western music.

Why are all of these programs really not considered educational? Why do educators who are from a constructivist perspective have to look to games for computer contexts for experimentation? Three commercial games designed for younger children incorporate some construction into them, and by considering them some issues regarding more desirable content will be raised. The three programs are designed after popular toys, and are made by Epyx. In the first program, Hot Wheels, children choose or build their car, and then can do a variety of activities with the car — go to a car wash, a demolition derby, or visit the fire station and go put out a fire with the fire truck. In the second program, Barbie, children can systematically vary Barbie's hair, dress and shoes, all in response to Ken's decision, given to Barbie in a voice over the telephone, about where they will go on a date. In the third program, G.I. Joe, you will have to imagine what children can experiment with because I did not review it. The point is that the process of experimentation is not enough, although it is important in and of itself. In the course of experimenting, there are many contents that are communicated to children, directly or subtly, that we need to carefully evaluate.

More important, games could be designed that with more intention provide opportunities for children to experiment with certain properties or objects or simulatable characteristics of the world (see Chaille & Littman, 1985). For example, one could envision a computer game similar to Bill Budge's Pinball Construction Set where younger children could create a series of simple inclines to roll a ball around that would affect the speed of the ball. By changing the length and angle of the incline they could construct a good deal of knowledge about the physical world in a game context.

Perhaps in the coming years with increasing capabilities we will see more construction kits, more opportunities for the kind of experimentation that facilitates the construction of knowledge in a self-directed context. With increased computer use by young children and in early childhood programs, we can only hope that there are constructivist options. It is important not to be totally locked into what currently exists for young children, and to develop a framework for evaluating software that is grounded in an understanding of how children learn and how we want children to learn. We need to search for, ask for, and encourage the design of software that is not only possible for children to use or liked by them, but that involves educationally appropriate uses of computer technology for younger children. Otherwise time spent on the computer by young children will be time replacing

other important activities, instead of the potential for extending experiences that the computer offers.

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COMPUTER SATURATION: GETTING MORE [F]OR LESS

Doug Cooper

This paper attempts to raise critical questions about the use of computers in education. Critical here does not mean blanket opposition but an effort to investigate taken-for-granted assumptions about the use of technology in our society. There have been numerous events from the use of pesticides to the accelerated deployment rate of nuclear weapons that have resulted in unforseen and undesirable consequences. This occurs because of an uncritical attitude on the part of those people who justify, design, promote, and disseminate technology. I don't mean to make a simple equation between computers and pesticides and nuclear weapons. However, the association between computers and the latter should give us pause to wonder about just what features of the human mind are being extended.

To ask critical questions about the role of computers in society and education is to go against the grain of both popular and professional enthusiasm for computer technology. That enthusiasm reflects the taken-for-granted belief that the inexorable advance of technology while attendant by some unanticipated and undesirable consequences, nevertheless, brings with it progressive improvement in life style.

This optimism reflects a viewpoint shared by many in educational computing. For example, Dave Moursand, in an editorial commenting on the purposes for having computers in schools makes the following claims for one of these purposes:

> The third type of purpose is to provide a high quality education for continuing lifelong learning, and for work, play and responsible citizenship in our (rapidly changing) Information Age society. A computer is a tool based on hardware and software. The computer tool aids human thinking, problem solving, and productivity. *Thus, the computer tool is at the very heart of the underlying mission or purpose of our educational system.* (Moursand 1986b,p.5)

I have added emphasis to the last sentence in the quote to draw our attention to what, I contend, is a great leap of faith. It relies on a logical argument that runs something like this:

> A. All educators already understand the importance of information and how one processes information to solve problems.
>
> B. A computer is merely [sic] a very fast machine designed to aid in the storage and processing of information.
>
> C. [Therefore] when computers are integrated into the everday content and pedagogy of the ordinary classroom, education will have moved into the Information Age (Moursand 1986a, p.4).

There is an implicit contrast here between viewing the computer as merely a tool and its function as a fundamental element in the process of school reform. Things fundamental are never mere.

I have chosen to highlight Moursand's comments because he is near to this conference as well as the editor of The Computing Teacher, a highly respected and practiced oriented educational computing magazine. But others sound a similar tone. Alfred Bork, Professor of Information and Computer Science and Director of the Technology Center at the University of California, Irvine, in a recent address to his department said, "We now have within our grasp the possibility of making major improvements in the very way people - from all economic classes and in all parts of the world - learn. We can transform the learning process, making it more attractive, more efficient and more powerful. We can assure that individuals learn to their full capacity. The key to all this lies in the computer" (Bork, 1987, p.38). The rational use of the 'key' will result in an educational system that will not have to depend on teachers. "We will have fewer teachers, more highly paid qualified teachers (Bork 1987b, p.7). The system would be technology-based rather than people-based due to the cost effectiveness of computers.

The investigation of these and others issues concerning computers in education has been instigated by my general interest in cultural studies and my experience in conducting ethnographic research in a computer-saturated classroom. The next section of this paper is a brief and selective description of that experience.

During the 1985-86 school year I participated in a research project that evaluated a computer-saturated classroom jointly sponsored by a local school district and the Apple Computer Company (Cooper, 1986). From early December to mid-June of that year I spent approximately 100 hours in the classroom talking ethnographic field notes and audio recording interviews and classroom talk. The goals of this experimental classroom as stated in the original proposal focussed on extending the "use" of computers in the usual sixth grade curriculum (Eugene School district 4-J 1985). There were no great promises made in terms of achievement only that the students in this program were expected to as well as or better on standardized achievement tests. The student population for this computerized classroom was randomly selected after controlling for equal sex ratio.

This classroom, The Apple Classroom of Tomorrow, represents a potential model for future educational environments. It attempts in both its name and practice to recognize inchoately the technological visionary's "cybernetic dream" (Berman, 1986) of educational programs completely serviced by computer and telecommunications technology. As one of the teachers in this classroom put it, "In the Apple Classroom of Tomorrow we enjoy living every computer educators dream of unlimited computer access for each of our students" (Caley, 1986, p. 38). A contrary prognosis might forecast educational programs that are in the service of that technology. In any event, this present study begins with reference to this actual, albeit experimental, situation in order to ground subsequent concerns raised here in the world of practice.

If the Apple Classroom of Tomorrow were not situated in a typical school building and if the bulletin boards did not display typical school decor, one might find it difficult to distinguish this public school classroom from a large modern

office production site or information processing center. The walls are lined with specially constructed desks on which sits an Apple IIe computer and a color monitor. On every third desk is an Imagewriter printer which the three adjacent students share via a printer selection switch box. An island of six student computer desks extends out from the left front wall. The teacher's work station, additionally equipped with a networking device and its own printer, stands at the right front wall in front of the storage cabinets. All of the student monitors are networked through the LINK system to the teacher';s computer. This arrangement gives the teachers the capability of superimposing the signal image transmitted from their computer on each student's monitor screen. The student's desk is equipped with a LINK control button which when depressed suppresses the image transmitted from their personal computer in order to facilitate clear reception of the teacher transmitted signal.

Over the course of the year school work was progressively computer related. By June virtually all of the learning activities were accomplished by using computer or video disk technology. The following excerpt from the report I submitted to the school district suggests the character of the classroom by the end of the year:

> The amount of time spent on LOGO, the decrease in the use of textbook materials, the decrease in the amount of time spent at the center tables for lessons, and the increase in the amount of time spent at individual computer desks are behavior patterns that attest to the computerization of the Apple Classroom of Tomorrow. By June 10, all academic activities were associated with the computer except spelling tests. The time spent at the center tables was of short duration and was almost always followed by a return to a computer related activity (Cooper, 1986, p.).

The program was extended and expanded for the 1986-87 school year to accommodate a new sixth grade class and to continue the program for the now experienced seventh grade students. In addition, the school district is moving ahead with its plans to implement the DaVinci School, the philosophy of

which, according to the district's computer coordinator, "is simply to encourage the extensive use of computers in every subject" (Register-Guard, Feb. 29, 1987, p. 1C).

The question I wish to raise is the appropriateness of the Apple Classroom of Tomorrow as a model for the future classroom. Do computer- saturated school environments tend to skew curriculum decisions in the direction of only computer compatible experiences? Does this over-reliance on computer technology and its associated software narrowly restrict the educational process in ways that deprive students of the opportunity to use the full range of their capacities? Does art become MacDraw?

Computer technology relies on explicit, consciously rationalized thought and action that can be formalized. Papert (1980) uses the notion of structured programming to make the point that "Some of the descriptive formalisms provided by computer science are exactly what are needed to get a handle on the process of learning a physical skill" (p.100). What we have here is the suggestion that learning a physical skill (walking, running, dancing, stacking blocks?) that normally requires an intuitive integration of cognitive and kinesthetic activity can be, more, should be formally captured by programming devices. And this is "exactly" what is needed. A moments reflection informs us that the process of learning a physical skill is not the result of conscious programming.

We need to keep the perspective on learning broad. The rationalistic tradition of modern science has enjoyed such great success and prestige that we are inclined to to think its paradigm is the essence of good thinking and intelligent behavior. But science and technology have not always been kind to this planet and its inhabitants. It's important to remain critical of the very means that we use to disseminate calls for change and progress. We need to work toward getting more for the children in our schools and not settle for less that looks like more.

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EMPOWERING ENVIRONMENTS, HYPERMEDIA AND MICROWORLDS

Christopher J. Dede

Unlike other necessities of life, information technologies are rapidly increasing in power while dropping in price. In another five years, schools will be able to purchase devices with greater capabilities than large research computers had five years ago. What new types of educational software will this next generation of hardware make possible? What will be the implications for students and teachers?

The Evolution of Instructional Devices

For over four decades, the capabilities of computers to process, store, and transmit information have steadily increased, while their cost has decreased. For example, ten years ago, $3500 could buy an Apple II™ with an 8-bit one megahertz processor, 48K of RAM, 8K of ROM, a 40-character by 24-line uppercase display, high resolution graphics [280 by 192, 16 colors], two 140K disk drives with controller, and an RF Modulator to connect with a television set. Adjusting for ten years of inflation, an equivalent amount of buying power today is $6800. For that price, one can buy a Macintosh II™ with a 16 megahertz 32-bit processor, one megabyte of RAM, 170K of ROM, two 800K disk drives, a 20 megabyte internal hard disk, and a 640 by 480 RGB display with 256 colors!

Comparable increases in computers' power/cost ratio are expected for another ten to fifteen years. By the 1990's, schools will be able to afford the equivalent of today's advanced engineering workstations. [However, by the early 21st century, physical barriers (such as the speed of light, the second law of thermodynamics, and quantum mechanical tunneling of electrons) will constrain the evolution of electronics; a shift to optical or biological architectures for computers will be required to push this trend further still.]

The external memory that computers can access has also been growing rapidly. A digital optical disc the size of a 45 rpm phonograph record (CD-ROM) now can store about 500 megabytes (250,000 pages) of

information. This is equivalent to what a secretary could generate typing eighty words per minute, eight hours per day, for eight years! When stamped in quantities of more than one hundred, these discs cost less than $5 each to produce, reducing the cost of "publishing" by three orders of magnitude.

In addition to lowering the price of accessing information, digital storage greatly increases the speed with which specific data can be found. As an illustration, a company, Quantum Access, has published on a CD-ROM a "State Educational Encyclopedia™" for Texas school administrators: one hundred thousand pages of information (federal and state education codes, Attorney General's opinions, Commissioner's rulings, etc), updated every three months. The unified index to this information is itself over 70,000 pages in length and includes all words in the documents except universal terms (such as "and, or, the")! As a result, a search can find in three seconds every paragraph in the one hundred thousand pages that contains a group of specified phrases (e.g. "handicapped," "reading scores," and "Montessori"). Such an "information utility" [Dede, 1985] can save much tedious scanning.

Numerous emerging hardware developments have implications for educational technologies. For example, the next generation of information technologies will synthesize the attributes of computers and telecommunications. Devices will emerge which combine the capabilities of the telephone, television, radio, printing press, computer, and copier. Already, real-time digitization of high resolution images (30 frames per second) is available for personal computers.

These advances in fusing the information technologies are proceeding very rapidly, driven by scientific breakthroughs, the global marketplace, and competition between vendors who previously had separate market niches (computers, telecommunications, media). The resultant decreases in cost are truly incredible--three years ago an optical scanning element capable of three hundred dots per inch resolution sold for over $2000; now it retails for less than $7.

However, all this increased power has little meaning unless software takes advantage of its capabilities. After all, what does it matter if a word processor can paste in 1/1000 instead of 1/10th of a

second? Fortunately, simultaneous with these hardware advances, our understanding of the potential of computers has expanded from number crunching to data processing to symbol manipulation. New types of applications have been created as our conceptions have become more sophisticated and as the power to support more advanced functions has become available.

The Next Generation of Educational Software

Historically, instructional usage of computers has evolved through different stages: computer literacy, programming languages, computer-assisted instruction, computers as tools (e.g. word processing, database, spreadsheet, graphics). Researchers in artificial intelligence and cognitive science are now developing two additional types of educational software: intelligent tutoring systems and "cognition enhancers." This paper discusses emerging cognition enhancers such as empowering environments, hypermedia, and microworlds [Brown, 1985]. (A synthesis of recent research in intelligent tutoring systems is given in Dede [1986].)

The concept underlying a cognition enhancer is that of using the complementary cognitive strengths of a person and an information technology in partnership. For example, computers have large short-term memories (megabytes of RAM), while human beings are limited to an immediate storage capacity of less than ten chunks of information [Anderson, 1983]. Computers can also execute complex "algorithms" (precise recipes for solving one class of problem) more rapidly than people. For tasks involving manipulation of successive symbolic results (e.g. involved mathematical calculations), these two cognitive attributes gives a computer an advantage over a human being. In general, computers are becoming superior at all standardized problem solving.

However, people store information long-term in rich "semantic networks" containing webs of associationally related textual, temporal, and visual imagery. For example, in a human memory the word "apple" conjures up religious, corporate, computational, botanic, and gustatory dimensions. At present, computers are much more limited in how their information can be interrelated, as anyone who uses a database knows! The cognitive attributes of human beings give them an advantage over computers at applying peripheral real world knowledge to ill

structured problems (such as diagnosing the source of a student's motivational difficulties). In general, people are still much better than computers at problem recognition, at metacognition (thinking about thinking), and at non-standardized problem solving.

Some researchers are working to develop stand-alone machine intelligence but, because of current limitations of computers, this task is very difficult. While intelligent machine-based tutors and coaches will gradually become useful in school settings, cognition enhancers designed to combine the cognitive strengths of humans and computers will evolve much more rapidly. These devices are still in their infancy, but so far three kinds seem to be emerging.

Empowering Environments

This type of cognition enhancer utilizes the computer's strengths in structured symbolic manipulation to empower human accomplishment by a division of labor: the machine handles the routine mechanics of a task, while the person is immersed in its higher order meanings. For example, I once took an oil painting course. My goal was to faithfully convey to a canvas the images in my mind so that viewers could share my experiences and emotions. However, rather than pondering form and composition and aesthetics, I spent my time trying to mix colors that remotely resembled my visualizations, trying to keep the paint from running all over the canvas, trying to keep the turpentine out of my hair. Now, I can use a graphics construction set to choose from a huge palette of colors; to alter, pixel by pixel, the contour of an image; to instantly "undo" my failures. I am involved with the deep semantics of art, while the empowering environment handles the mechanics.

Researchers are just beginning to understand how to design this type of cognition enhancer. On one level, a rich comprehension of a domain is necessary to generate an optimal menu of manipulable symbols and processes for the user. As an illustration, in building an empowering environment for a programming language, what array of debugging aids and compilers and code generators should be included? (DiSessa's [1986] work on BOXER illustrates the evolution of an advanced educational empowering environment for programming.)

A second type of design issue is the range of tasks for which empowering environments would be useful. For example, would a "myth construction set" aid anthropologists? As a third concern, what further capabilities should empowering environments possess? Intelligent coaches with embedded models of performance expertise, "cognitive audit trails" to allow metacognition about performance, shared computational environments to aid decision making and cooperative work, and consciousness sensors to monitor the user's motivation and mood are all possibilities [Proceedings: Computer-Supported Cooperative Work, 1986].

Primitive empowering environments are beginning to be used in education. A word processor with spelling checker, thesaurus, typing tutor, and graphics tool is the beginning of an empowering environment for writing. Even the early versions of this type of cognition enhancer have an interesting property: their usage unconsciously alters the style of task performance!

For example, as a result of using a word processor, I no longer can write well with a paper and pencil. I used to compose a sentence by thinking for a couple minutes and setting down a final version that was about 90% of optimal; I "took my one best shot" because making changes later would involve massive physical cutting and pasting. Now, I write by thinking for half a minute and typing in a sentence that is perhaps 40% of optimal, think for another fifteen seconds and make a change (now 50%), another change a few seconds later (65%), and so on. The same amount of time is required to get to the 90% level, but now my psychological momentum is behind revision and polishing rather than producing a single "finished" product, and no cognitive dissonance bars the sentence from eventually evolving to optimal.

However, when I try to write with a pencil using this new, superior strategy--disaster! Most people who use word processors (music tools, databases, spreadsheets) experience the same unconscious shift in style. In a world of intelligent empowering environments, the ways we accomplish tasks may alter.

Hypermedia

Even with a sophisticated empowering environment for desktop publishing, I can still get writer's block.

A second type of cognition enhancer is needed: "hypermedia" is a framework for non-linear representation of symbols (text, graphics, images, software code) in the computer. As discussed earlier, long-term human memory is stored as associational semantic networks; I can know everything I want to write, but not have my ideas in the linear "stream" required for written or oral communication. I need an "idea processor," a way of creating externally a multi-dimensional construct which mirrors the concepts and links forming the material in my memory. With my knowledge externalized into a hypermedia system, I then can traverse this network along alternative paths through nodes and links, seeking the right sequential stream for my intended content, audience, goals. The computer is working in cognitive partnership to eliminate the overload involved in transferring long-term to short-term memory. Also, a person's access to long-term memory may be enhanced by the process of building and using hypermedia.

Hypermedia is a general tool that can be utilized in several different ways. In addition to serving as an externalized associational memory for an individual, hypermedia could be an alternative representational system for a large, shared database (such as an integrated textbook series for the entire curriculum). Such an approach would encourage group interdisciplinary exploration by explicitly interconnecting similar ideas in different subjects. (The INTERMEDIA project at Brown University [Yankelovitch, 1986] is one illustration of educational applications of hypermedia.)

Or, an "inference engine" can be built onto a hypermedia framework. For example, some software engineering projects are using a "truth maintenance system" to propagate changes made in one part of the code into their consequent impacts on other sections of the program and documentation [Narayanaswamy & Scacchi, 1987]. In this way, programmers can avoid making a change that introduces more bugs than it fixes.

The emergence of primitive hypermedia systems on personal computers is likely to unleash a variety of new ideas about uses for this type of cognition enhancer. (For those readers interested, a Macintosh-based hypertext version of this paper is available from

the author.) Perhaps new styles of remembering and knowledge transfer will evolve as well!

Microworlds

This third type of cognition enhancer allows the user to explore and manipulate limited "artificial realities." A problem that learners constantly experience is how to relate abstract, formal knowledge to specific real world situations. For example, if I were teaching how Einstein's theories of general and special relativity had altered our understanding of gravity, I could approach this task by explaining the appropriate equations and formulas to my students. However, even if they had the logical reasoning skills and the background in physics and calculus to understand my exposition, few would be able to link their abstract comprehension to real world applications (such as why water swirls down drains in opposite directions in the Northern and Southern hemispheres).

What I need is a "microworld," an artificial reality in which I can vary gravity's fundamental properties. The students could use the computer to explore some activity (say, baseball) at earth gravity; then, at the Moon's gravity; then Jupiter's gravity; even a very short game at zero gravity! Varying one item at a time, we could work through the constants and variables in the equations, altering each in turn to see how the game of baseball would change. Now, students would have both a formal and an applied knowledge of the theories underlying gravity.

The concept of microworlds extends to "surrogate travel" and "surrogate experience." Taking advantage of the emerging synthesis between telecommunications and computers, interactive videodiscs could allow an individualized "trip" to be taken to the Louvre in Paris. The student could "walk" through the Museum examining art objects in any order, at different angles, for any duration, with or without commentary, with hypermedia links to related subjects. This experience would not be the same as actually visiting the Louvre, but would be far more instructive and motivating than group viewing of art history slides!

Or, surrogate experience could be gained in a profession (say, medicine) by having the student use an interactive videodisc to interview a "patient," make a

diagnosis, and prescribe a therapy. This experience would be far different than a structured problem at the back of a text chapter; the student would need to spot visual cues, elicit information essential to the diagnosis, and determine the accuracy of the patient's responses. As with computational microworlds, key variables could be manipulated in surrogate travel and experience to encompass the range of situations in which abstract, formal knowledge is useful.

Users find microworlds very motivating; in fact, researchers are studying videogames as an example of artificial realities to determine what makes some so interesting and how to generalize this reinforcement to educational situations [Lepper & Malone, 1987]. Learning environments such as the Logo language and the simulations now used in classrooms are the beginnings of microworlds; the work of Smith, O'Shea, and Scanlon [1987] on the Artificial Reality Kit (ARK) illustrates an advanced educational microworld.

Summary

Empowering environments, hypermedia, and microworlds illustrate the variety of cognition enhancers under development. Further exploration is needed to learn more about how partnerships between people and intelligent tools can improve learning; additional research is required to comprehend how best to design cognition enhancers; and the emergence of powerful, inexpensive information technologies is necessary to empower their usage in schools. All of these initiatives are underway, but what will be the ultimate effects of moving education in this direction?

Implications for Educators of Cognition Enhancers

Isaac Asimov, science fiction writer, once said that the important thing to forecast is not the automobile, but the parking problem; not the income tax, but the expense account; not the television, but the soap opera. Similarly, the fundamental issue is not how many empowering environments, hypermedia systems, and microworlds will be in classrooms and homes in a decade, but how they will change the relationship between student and teacher, school and society. Illustrative potential impacts of the widespread, long-term usage of cognition enhancers are listed below;

more detailed expositions are given in Dede [1987] and Dede and Freiberg [1986].

--Human strengths in partnerships between people and cognition enhancers involve skills such as creativity, flexibility, decision making given incomplete data, complex pattern recognition, information evaluation/synthesis, and holistic thinking. Such higher order mental attributes might become a new definition of human intelligence, as basic cognitive skills would increasingly shift to the intelligent tool's portion of the partnership. Polishing students' mastery of lower level skills would be like grooming John Henry to compete with the steam engine!

--Students would still need fundamental descriptive and procedural knowledge--one cannot master higher order skills without a foundation of lower order concepts and processes--but the goal of teaching basics would shift from performance fluency to providing a cognitive underpinning for sophisticated problem recognition and unusual problem solving. Methods of educational assessment would alter from charting mastery of descriptive knowledge to evaluating attainment of higher order skills. Fortunately, cognition enhancers can aid in collecting the detailed individual data necessary, as well as empowering more sophisticated empirical educational research.

--"Learning-while-doing" would become a more significant component of education, as combined computer and telecommunications technologies allow delivery of instructional services in a decentralized manner. To allow credit for occupational accomplishments, workplace tools may include intelligent devices that act as job performance aids while simultaneously collecting a cognitive audit trail of user skill improvements, creating increasingly informal systems of credentialization. Occupational roles will alter rapidly as the evolution of information technologies drives the knowledge-based economy, and adults may become a major clientele of schools [Office of Technology Assessment, 1984].

--Widespread use of cognition enhancers would facilitate the participation of every person associated with the educational process--learner, teacher, administrator, employer or parent--in shaping instructional outcomes. Society's five primary educational agents (schools, family, community, media, workplace) could act in more coordinated fashion to shape the learning environments of individuals through the use of interlinked "educational information utilities" which supply access to a variety of data, courseware, tools, and training [Dede, 1985].

--Productivity gains from a mature, technology-intensive educational approach could enable a higher overall ratio of students to teachers, but smaller class sizes for group instruction (through supplementary use of intelligent technologies and non-school instructional agents) [Melmed, 1986]. Teacher salaries would be better, and the total educational workforce might increase due to a wider range of clients. Given equivalent expenditures, instructional outcomes would be significantly higher.

--Long term, the effects of intelligent technologies on cognitive style, personality, and social skills may be profound [Turkle, 1984]. The television and the computer have each demonstrated the capability to shape the attributes of youngsters immersed in their usage. The deliberate tailoring of individualized, information-intensive environments could produce a generation radically different in its characteristics from any previous. For example, a technology-intensive model could incorporate interactive learning situations designed to build the affective skills of cooperation, compromise, and group decision making essential in a knowledge-based economy.

--Educational equity could increase through the power of intelligent systems to individualize instruction. Because the economic strength of a knowledge-based democracy is dependent on universally excellent performance by workers and citizens, each member of society would have a strong self-interest in promoting optimal educational achievement by all learners.

Conclusion

The potential implications for civilization of intelligent educational environments could be profound. The next generation of information technologies could become history's first "knowledge medium:" humanity's conscious mechanism for tailoring its cognitive evolution [Stefik, 1986]. For example, in the final chapter of his book, The Selfish Gene, Richard Dawkins suggests that ideas (he calls them "memes") are like genes. This opens up a myriad of analogies: meme pools, mimetic drift, mutation, displacement, and even recombinant memes. Education would be a crucial component in a society's attempt to increase knowledge and wisdom through intelligent tools which aid in the collecting, filtering, modeling, and sharing of massive amounts of data and information.

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CHANGES ON THE HORIZON IN DATA STRUCTURES

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As the field of Computer Science comes of age, many instructional methods become generally accepted with little, if any, professional review. Not only have data structure courses failed to find an acceptable standard, they have been void of the clear principles which bring required coherency to such a course. Fortunately, several concepts are gaining acceptance which may potentially alter techniques commonly found in these courses. This paper examines the current view and explores two key ideas contributing to a new concept of data structure courses.

The Way It Was / The Way It Is

Why Teach Data Structures?

Clearly defined reasons for teaching data structure courses do exist. The earliest motivation was to teach a course reaching beyond the introductory level. This course generally emphasized advanced programming concepts. As the course progressed we accepted the importance of exposing the student to common programming techniques and algorithms in use today. Concepts like strings, linked-lists, stacks, queues, trees, searching and sorting preoccupy these courses. Most recently, program optimization, space and time efficiency and order notation have become popular additions to data structure courses.

Even with new justifications appearing, the existing purposes for teaching the concepts of data structures remain valid. The initial goals are consistent even though significant changes are proposed to the applicable teaching methods. We teach this course and allow it to dominate the Advanced Placement curriculum simply because we recognize it relates to the maturity gained and the important ideas considered by students in their study of computer science.

Currently, two concepts are changing the nature of the data structure course. The first is **information hiding**; the second, **abstract data types**. Both concepts are quite easy to understand.

Information hiding is the concept of placing programming detail at a level at which it does not interfere with the task at hand. For example, in evaluating expressions it may be useful to place an operator on a stack and later retrieve it. The task is evaluation of the expression, the detail of how the stack functions should be therefore be "hidden." Both the exact implementation of the stack and the details of how the operation is performed should be hidden by placing them into a procedure or function. This procedure or function is then called when required by the task at hand. If possible, all data associated with the stack operation should be encapsulated with it.

Abstract data types are the combination of the data structure and all the operations performed on it. More formally: "An abstract type is a set of values and a set of operations on those values." [Moffat,86]

The concepts of information hiding and abstract data types alter the nature of our data structure courses. To more fully understand why these ideas change the nature of our courses, it is desirable to review how we currently teach most data structure courses.

Current Methods of Teaching Data Structures

Many courses begin by introducing the importance of data structures and their general applications to computing. The next common step is to systematically introduce linked lists, stacks, queues and trees in roughly this order. Each algorithm is considered in turn with emphasis upon its implementation. In addition, the instructor often gives hints on how to write associated code. In general, the course uses a bottom-up approach which derives the data structure implementation first, the details of the operations second and the applications last.

Many instructors emphasize the relationship between a data structure and the operations performed on that structure. (For example, the push and pop operators of a stack.) In creating these operations, students are often encouraged to build independent functions or procedures (PUSH, POP) which can accept the name of a particular data structure (STACKA, STACKOPERATOR). These modules are more flexible and can be used without modification in situations where more than one of a given data structure is present. Some instructors also require the student to place debugging tracers into the code permanently, providing for flexibility during the application of the procedure.

In general, these classes emphasize implementation strategy along with the detail necessary for each data structure. Very few courses have treated this strictly from the perspective of information hiding and abstract data type. Application of these two new concepts causes the course to be approached in a top-down manner and adds to the basic objectives those related to more mature programming methodologies.

The impact of this new approach is to help our students write better programs, design better programs, and recognize better programs. "Better" in this context means programs which are correct, maintainable, within budget, and perform the required operations.

In addition, the application of these new approaches brings the course more in line with the way Computer Scientists are viewing data structures. They see data structures from an increasingly abstract point of view. This view is similar to the one we all take regarding the built-in functions.

If the data structures were completely built into the language (like numeric and string functions in many compilers) we would able to approach the topic in an abstract manner and would expect the student to work with the operation before attempting implementation. Except in courses specifically designed to examine the implementation of these functions, the details of both data and construction would be hidden from view and is rather unimportant to the utilization of the function. This distinction is at the root of the changing attitude about data structures, requiring us to approach the data structure from an abstract point of view.

This approach begins with a concentration on the concept of the data structure and its operations without regard for the underlining implementation. The end result is that the actual data structure is hidden from view while only the operations are visible.

When provided with basic procedures and functions to operate on the data structures, the student immediately views them as abstractions.

This abstract view permits the student to consider applications of the data structure before implementation details.

Difficulties in Implementing This Approach

There are two major problems in altering our courses to incorporate information hiding and abstract data types. The first is that of creating built-in functions and procedures for data structures. The second being to gain a coherent and abstract view of relationships between the various structures.

The first problem is related to the type of compilers available for our classes. In cases where independent subroutine libraries can be constructed, the instructor can develop libraries of functions and procedures to be added to the student's code at compile time. Willamette University has experimented with this method and found it to be highly successful.

In other cases the instructor may be able to compile and store procedures and functions which are called from the student's program at runtime. Regardless of the approach, it is essential that the student not be given the actual source code.

The primary challenge of a data structure course is writing the procedures and functions themselves. One successful approach is to have the student write an application using the instructor supplied functions and procedures. When this is complete the student writes the same program again (no change is required to the mainline), implementing the procedures and functions themselves. One benefit of this approach is that the student has a working model at hand during the development process.

The second problem is one of gaining a systematic view of the interrelationships between the various data structures. Figures 1 and 2, (SIGCSE BULLETIN, Volume 18, Number 4, Pages 58 and 59) describe one coherent view of the relationships between various data structures and the procedures and functions commonly applied.

At first glance, there appears to be unfamiliar structures present. This results from the dichotomy used in the construction. Data structures can be divided by several criteria: destructive and non-destructive accesses, sequential or direct access, linear and non-linear. In Figure 1, both the familiar destructive (stack, queue) and the less familiar non-destructive (sequence, reverse sequence, ordered sequence) structures are provided. In the case of non-destructive data structures, the accessed element remains in the structure rather than being deleted as in the case of destructive access.

The careful reader will note that in Figure 2, some common operations will not be present under certain implementations of the data structure. The key idea is that data structures should be viewed from the perspective of abstract forms and the operations performed on the structure defined without regard to the implementation of the structure itself. For example, it is essential the stack have a FULL operator defined even if its implementation is in a linked list. In this case, the FULL function should be written to simply return FALSE. Note that to omit the function is to abandon the principle of the abstract structure.

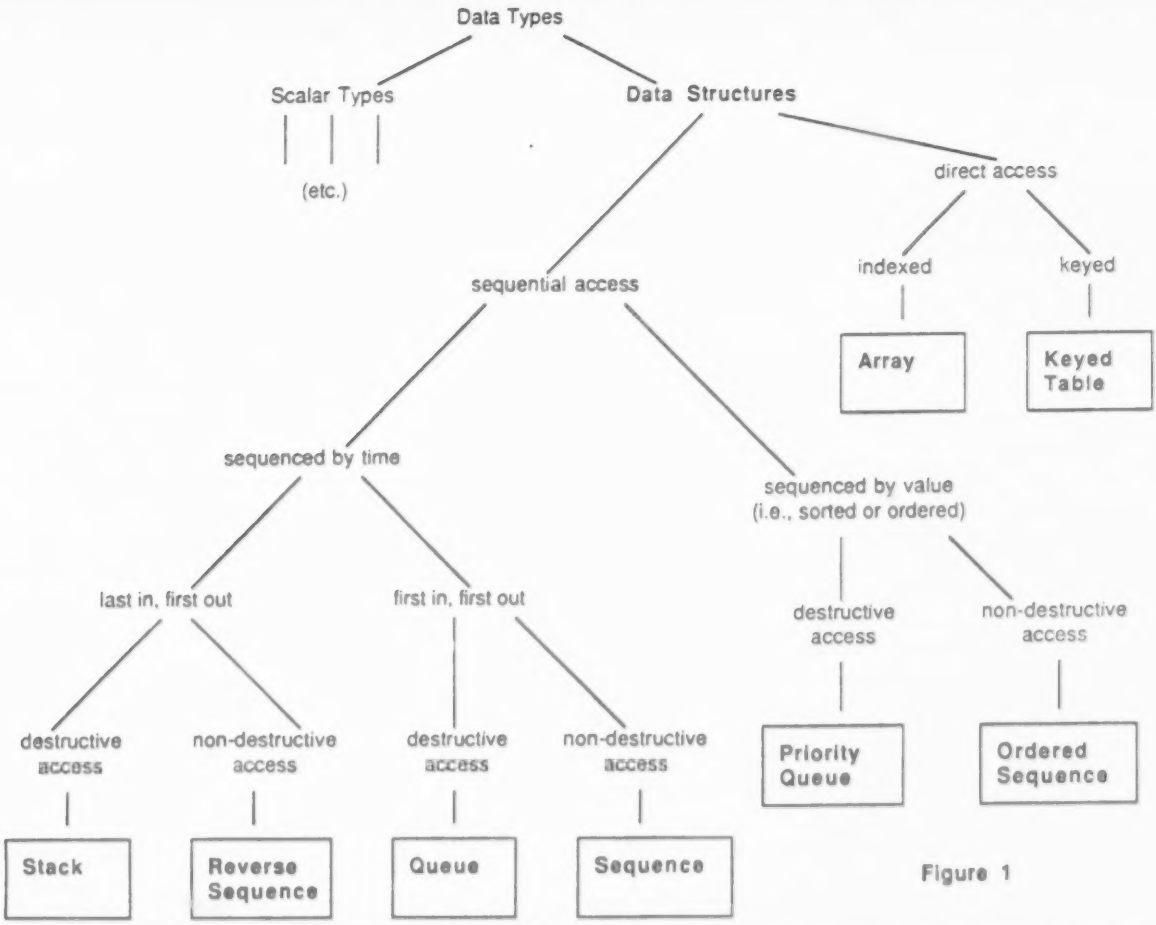

Figure 1

Common operations:	Stack	Queue	Sequence	Priority Queue	Ordered Sequence	Array	Keyed Table
creation (and initialization)	create(stk)*	create(q)	create(seq)	create(pq)	create(ord)	create(a)	create(tab)
reinitialize to empty	reinit(stk)	reinit(q)	reinit(seq)	reinit(pq)	reinit(ord)	reinit(a)	reinit(tab)
test for empty	empty(stk)?**	empty(q)?	empty(seq)?	empty(pq)?	empty(ord)?	empty(a)?	empty(tab)?
test for full	full(stk)?	full(q)?	full(seq)?	full(pq)?	full(ord)?	full(a)?	full(tab)?
request size	size(stk)	size(q)	size(seq)	size(pq)	size(ord)	size(a)	size(tab)
Characteristic operations:							
store a value	push(stk, x)	enqueue(q, x)	append(seq, x)	enqueue(pq, x)	insert(ord, x)	put(a, i, x)	put(tab, k, x)
retrieve a value	pop(stk, x)	dequeue(q, x)	next(seq, x)	dequeue(pq, x)	next(ord, x)	get(a, i, x)	get(tab, k, x)
remove a value	[pop]	[dequeue]	---	[dequeue]	---	delete(a, i)	delete(tab, k)
Characteristic and supplementary operations:							
retrieve a value	last(stk, x)	first(q, x)	---	first(pq, x)	---	---	---
positional	---	---	reset(seq) atend(seq)?	---	reset(ord) atend(ord)?	---	---
query content	---	---	---	---	---	---	found(tab, k , x)?

Figure 2

* Common operations would actually be named, for example, CREATEx, where x is STK, Q, SEQ, and so on, to differentiate among the structures to which they apply.

** "?" denotes a boolean function. SIZE is an integer function. All others are procedures.

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Conclusion

Careful application of these new ideas will ensure a higher quality of programming. Specifically, the programer can write without regard to implementation details. They can rely on the fact that a program will run correctly even when ported to a system with a different implementation of the data structures. Finally, the programmer can be assured that all functions used will return reasonable, even if trivial, results.

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USEFUL PUBLIC DOMAIN SOFTWARE FOR EDUCATORS

for

The 6th Annual (1987) Summer Conference
Extending the Human Mind: Computers in Education

by

Kurt Gustafson

The Educator's Problem

Educators of today are encouraged to make use of new tools as they become available. The most notable in recent years, of course, has been the micro-computer. In order for educators to become proficient with this new tool requires a generous amount of time and effort. In addition, large portions of already sparse budgets must be used to obtain the software that make the computer a useful tool in the business of teaching and learning. It is often discovered, too late, that costly commercial software does not meet the specific needs for which it was purchased. It then gathers dust on the shelf, and money that could have been better spent is wasted. Becoming proficient in the use of micro-computers and the associated software simply takes time and practice, but a partial solution to the financial difficulty of obtaining software is the software found in the many public domain sources.

What is Public Domain Software?

In a word, public domain software is free. Sometimes a small charge is made for duplication and shipping, but usually this is usually less than $5.00 per disk and sometimes as little as $1.00! Like commercial software, PD software can be obtained in every category including applications, games, nutrition, electronics, business, education, and utilities. They can perform almost any computer task so that you and your computer can experiment in new applications that cost may have prevented you from before. Also, like their commercial cousins, PD software is of varying quality. For the most part PD software lacks the thorough documentation that accompanies commercial programs. This is usually not a major obstacle because programs in the public domain tend not to be as complex, and perform only a single task per program. Public domain disks nearly always contain several programs per disk (up to 30 or more!) of varying utility.

How to Get Public Domain Software.

There are many sources of public domain software. On-line services such as Compuserve and The Source allow users to download programs using modems. Magazines are another good source of PD programs. You can type in the listings, or for a small fee a disk can be purchased from the publisher for the same program. Some good magazine sources are Nibble, Computist, A+, The Computing Teacher, and most other educational computing journals.

User's groups probably provide the most abundant source of PD software. Some user's groups charge non-members fees for software, and offer it free or at very low cost to members. Most large cities have user's groups organized around different makes of computers. These groups can be contacted through computer stores or through university or college computer departments.

Potentially larger PD software sources are national user's groups such as the Big Red Club (BRC) of Norfolk, Nebraska. This group has an extensive library of PD software which is constantly expanding. Membership to BRC is $12.00 per year and includes a monthly newsletter, "Scarlett", which describes new PD software, offers technical help, tips, reviews, and educational applications of PD software. BRC has a PD library of over 3000 programs which are available for $2.50 per disk (less if you order more than 10).

The International Apple Core (IAC), headquartered in San Jose, California, also has a huge library of PD disks and will send you a descriptive catalog called Apple][Public Domain Software Library Catalog, upon request. IAC charges $4.50 per disk and offers other services as well.

A hybrid PD source is the Public Domain Exchange (PDE), of San Jose, California. This is a "commercial" public domain source that offers some special features others do not. PDE has a staff of reviewers that screen all incoming software before it is added to their library. Poor quality is weeded out, and programs that are accepted are grouped together on categorical disks when possible. PDE publishes a newsletter which contains reviews, tips, and applications. In addition, two books, The Best of Apple Public Domain Software, and The Best Mac Deal, have been published and categorize and describe most of the best PD programs available.

The best buy for PD software is found at the Computer Learning Center (CLC), of Tacoma, Washington. PD volumes cost only $1.00, and CLC's library is as complete as the best of the rest. CLC also sells PD Special Collections for even greater savings (Eamon, Business & Finance, Games, Utilities, Math & Tutor). CLC also publishes "COMPUTIST", an Apple journal for advanced users.

What To Do When You Get Public Domain Software?

The first thing one must do upon receiving PD software is determine which programs from each volume will help you achieve instructional goals (content area programs), help you implement some task (application and utility programs) or fill some other need (entertainment?). To do this you should pull up a comfortable chair in front of your computer, have paper and pencil handy, and systematically experiment with each of the programs in turn, to see features, strengths and weaknesses. Since printed documentation rarely accompanies PD software it is good practice to write down some operational procedures and general descriptive notes for each of the programs you survey. If you have acces to a "push button" print dump card for your computer you can also print the screens of information that are displayed by the programs. Usually the more complex PD programs will have documentation as part of the program, or as a separate text file that can be printed either from the program itself, or from a word processor.

Organizing Your Collection.

After you have begun to amass several sets of PD programs and program notes you will find it useful to organize your disks with some kind of numbering system, and assemble your notes in a three ring binder by categories and indexed with disk numbers. It is advisable to do this early in your collecting, because PD collections tend to grow quickly and it is easy to forget what a particular program does, or what disk it was stored on.

Some Notable Programs

FrEdWriter & Co.: A very good word processor.

FrEdWriter is a program written by Al Rogers of the CUE SoftSwap Project. This program is an improved ProDOS version of FreeWriter, written by Paul Lutus of AppleWriter fame. This program is surprisingly powerful, and yet is easy to learn. Most of the feature commands use single letter codes that match the first letter of the function to be performed (ie. <N> is for New screen). FrEdWriter contains four text files of ample documentation which can be printed by FrEdWriter. At any time during operation the user can consult a built in tutorial that summarizes all commands. This program will operate in 40 or 80 column video display on Apple][,][+,][e, or][c. Included in the program is a feature called "prompt boxing" which is used to help young students in writing skills, or anything else you would like to prompt responses for. An extensive set of prompt-box lessons on popular children's books is available from CUE Inc. SoftSwap. Also available is "FrEd Tips", a disk of further documentation, tips, lessons on how to use FrEd and prompted lessons, and FrEd hardware tips. Spanish FrEdWriter information can be obtained from Hands-On Training Company. It is hard to believe that this program is free once its power is revealed!

DB Senior: A simple, powerful data base program.

DB Senior is a powerful menu driven data base program with many features including alphabetical or numerical sorting, linear or binary searching, record deletion, and reversible scrolling. Included on the disk is a comprehensive manual which can be printed using any word processor that handles standard text files. DB Senior can be obtained from the Big Red Club.

PS Graphic Grabber 3.0: The 1st & best PSG converter.

The Print Shop Graphic Grabber, by Ray Darrah, is a utility for Broderbund's popular Print Shop. With the Graphic Grabber you can take portions of any previously captured high resolution graphic screen. This means that artwork from the many drawing tablets, and graphic drawing programs can be used to add to your 'graphic' collection. The Graphic Grabber has the ability to stretch the X and/or Y axes of its capture window. This allows the user to use up to an entire high resolution screen as a 'graphic'. Once the desired

The programs described above are only a tiny fraction of the thousands available in the public domain. While only a few of these programs boast all the bells and whistles of their commercial counterparts, nearly every one will fit a niche and fulfill a need somewhere. Listed below you will find the names and addresses of a few of the more popular public domain sources.

Apple SOURCES

The BiG Red (Apple) Club
1105 S 13th, Suite 103
Norfolk, Nebraska 68701
(402) 379-4680

Computer Learning Center
PO Box 110876
Tacoma, Washington 98411
(206) 474-5808

Mid-Willamette Apple BBG
1581 NW Terrace Green Pl.
Corvallis, Oregon 97330
(503) 754-1915

Computer Budget Shopper
2203 Park Avenue O.V.
Cheyenne, WY 82007
(307) 635-2173

Apple Avocation Alliance (3A)
1803 Warren Avenue
Cheyenne, WY 82001
(307) 632-8561

The Public Domain Exchange
673 Hermitage Place
San Jose, California 95134
(408) 942-0309

International Apple Core
Public Domain Library
908 George Street
Santa Clara, CA 95054
(408) 262-9114

Apple-Dayton
Box 1666
Fairborn, OH 45324

Hands-On Training Company
4021 Allen School Road
Bonita, CA 92002

CUE Softswap Project
SMERC Library & Micro Ctr.
San Mateo Office of Edu.
333 Main Street
RedWood City, CA 94063

area is surrounded, it is scrunched down to 'graphic' size, and can be saved and used as is with Print Shop. Since some resolution is lost in the scrunching process, another feature allows the density of lit pixels to be intensified or diminished as you wish. The Graphic Grabber is available from the Computer Learning Center.

EAMON Adventures: Imagination vacation & map skills!

The EAMON adventure series has over 100 disks, each containing an adventure scenario. In addition to great fantasy role playing, one must use careful record keeping and develop accurate map drawing and reading skills. Playing these adventures is only the beginning of the fun and learning though. Eamon also has a scenario designer disk and three utility disks which allow you to create any world, ecosystem, or society your imagination can dream up. Your scenario can be realistic, fantastic, serious, or funny; the choice is yours. All of this is possible through a powerful menu driven program which prompts you for descriptions of up to one hundred each of places, things, special effects of things, and people/animals/creatures. Through your imagination and the easy to use editor you can create scenarios to fit historical events, future possibilities, or environmental/ecological situations. Simply put, this scenario designer is an advanced simulation designer. Eamon is available from any of the public domain sources including Big Red and the Computer Learning Center.

TAWUG: Hundreds of AppleWorks templates (WP/SS/DB).

At last count, forty two disks full of AppleWorks templates were available from The AppleWorks Users Group (TAWUG). If you use Appleworks you owe it to yourself to examine the TAWUG catalog disk and/or a few of the disks. Though the templates are not categorized (yet), there are many form letters perfect for mail merge applications, spreadsheets for library, business and home applications, and data bases for everything from astronomy to zoology. These disks are available from the Mid Willamette Valley Apple BBG.

MPG CrackPak: Superior disk utilities.

The MPG CrackPak is a collection of powerful disk utilities. Some of the utilities like Advanced DeMuffin, Ram Disk, and FastLoad are for the more advanced user, while others such as Disk Muncher, and Beautiful Boot are for everyone. Disk Muncher is an extra nice disk copy program that can back up your precious data disks, or duplicate your program disks in a mere 30 seconds! Beautiful Boot modifies DOS 3.3 so that you get a customized (beautiful) boot program complete with falling stars, sound effects, and your name! Many other utility programs and complete documentation are on this double sided disk also. It is available from the Mid Willamette Valley Apple BBG.

BRC Volumes C1 and C10: Lots of great math programs!

These two Big Red Club volumes contain many high quality math programs on many topics including estimation, fraction operations, matrix coordinate systems, basic skills, measurement, function plotting, and factoring. All of the programs have great graphics, some of which are very large which make them perfect for class demonstrations. A couple of them allow for more than one player and competition. BRC has many other educational disks in various curriculum areas.

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LITERACY PROGRAMS USING CURRENT TECHNOLOGY

Pat Heerman

The problem of illiteracy in the United States has received a great deal of attention the past few months from government officials, educational bodies, and private industry. Estimates presented state that 13 percent of all adults in America cannot read or write at a sixth grade level.

With 35 years of experience in the field of education, Dr. John Henry Martin has devised two systems that address the teaching of writing and reading skills using current technology along with his theory of education. The first program is titled "Writing To Read" and is a system for promoting growth in the kindergarten and first grade age groups. His second program is called "Principle of the Alphabet Literacy System" (PALS) and has, for its objective, helping adolescents and adults achieve higher levels of reading and writing skills. More detailed information on both programs follows.

Writing To Read

Writing to Read creates a multisensory, multidimensional language center that is specially tailored to the needs of children. The environment is active -- highly motivational and filled with bright colors, lively graphics, voices and sounds, as well as multiple learning stations. It is designed to stimulate and hold the interest of children as they learn.

Dr. Martin's program teaches children to write what they can say and to read what they write. His method builds writing and reading skills before a child has mastered the intricacies of spelling in the English language. Using a phonemic spelling system, Writing to Read encourages students to focus on how individual letters represent sounds which produce words and how words form sentences.

For one hour a day, children come to a classroom dedicated as a Writing to Read learning center where they use a variety of equipment, including IBM Personal Computers with speech capability, and various educational materials organized into five learning stations.

Teachers, after receiving inservice training and with the assistance of a center aide, are the educational managers, monitoring each student's progress and assisting with individual learning needs. These needs are determined as children progress at their own pace. Students are further stimulated to learn by working side by side with their peers on some portions of the program.

The Writing to Read center consists of the following five stations.

Computer Station

At the Computer Station children work in pairs with an IBM Personal Computer equipped with a Speech Attachment that enables the computer to "talk" to them. With its natural-sounding "voice" and its interactive programming, the computer offers each student self-paced instruction.

The children spend about 15 minutes at the computer, interacting with their partners and responding to instructions given by the computer "voice." Students respond to exercises presenting the 42 phonemes within the context of familiar words. Upon completion of all cycles, children are acquainted with writing and reading the sounds that make up spoken English.

Work Journal Station

At this station the children listen to a taped lesson for reinforcement of the sounds they learned at the computer.

During a cycle of study, children mark their progress on the back page of the work journals. They take the completed work journals home for discussion of their development with parents. This parental reinforcement is a natural extension of the Writing to Read program's intent to generate excitement for learning to write and read.

Listening Library Station

As the children listen to recordings of carefully selected children's literature, they follow the text in books. The Listening Library is designed to familiarize students with words and to give them a chance to match speech with written English.

Writing/Keyboard Station

This station has two learning areas -- Writing and Keyboarding. The Writing station is a special place where students know their task is to write. They have easy access to writing tools with which to experiment with the discoveries they are making about letters and sounds.

IBM Personal Computers are used at the Keyboarding station, giving young learners a faster, easier means of writing than hand lettering. Without fretting over creating each symbol by hand, they build speed in letter recognition and word formation through the use of the keyboard.

Make Words Station

After hearing and seeing words in print and at the computer, students discover they can recombine letters to form new words. Through games and hands-on use of materials, like clay, crayons and chalk, students investigate new combinations of letters and words at the Make Words Station.

Evaluation of Writing To Read Effectiveness

Educational Testing Service of Princeton, New Jersey, was commissioned by IBM at the beginning of the National Demonstration Project to provide an evaluation of the effectiveness of the Writing to Read system. Their findings, released in July of 1984, were:

Overall Conclusion. Writing to Read is a powerful and effective educational program.

Conclusion 1. Writing to Read works as an instructional system.

Conclusion 2. Kindergarten and first-grade children demonstrate the attainment of progressively complex writing skills with Writing to Read.

Conclusion 3. Writing to Read children in kindergarten and first grade write significantly better than comparison groups.

Conclusion 4. Kindergarten Writing to Read students gain a significant advantage in reading ability over non-Writing to Read students.

Conclusion 5. Kindergarten and first-grade Writing to Read students progressed faster than the national norm comparison groups on standardized reading tests.

Conclusion 6. Writing to Read students perform as well as non-Writing to Read students on spelling.

Conclusion 7. Teachers of Writing to Read children report greater progress of their children in writing and reading than teachers of non-Writing to Read students report.

Conclusion 8. Parents of Writing to Read children report greater progress of their children in writing and reading as compared to parents of non-Writing to Read children.

As Writing to Read has been implemented in school systems across the country, administrators and teachers have consistently reported dramatic results.

Students who have gone through the program have shown marked improvement in their writing and reading skills. The majority of Writing to Read alumni raised their percentiles several points on standardized reading tests in relation to their peers.

Principle of the Alphabetic Literacy System

Dr. Martin's second offering, "Principle of the Alphabet Literacy System" is reaching out to adolescents and adults with reading and writing ability below the sixth grade level. Once again he combines the newest technology, the IBM InfoWindow system, with his innovative teaching method.

This program is an interactive instructional program. The IBM InfoWindow system is an exciting presentation tool that combines the power of the personal computer with the flexibility and excitement of the laser videodisc. Together, these elements produce an effective literacy program.

The Principle of the Alphabet Literacy System is based on a fable in which an alphabetic system is invented to prevent war between two kingdoms. The story is intended to dramatize the importance and power of the written word, and reinforce, through vivid examples, the necessity of learning to read and write.

By interfacing with the program through the InfoWindow system, students learn the alphabetic principle, or how to combine the 26 letters of the alphabet to form words. In addition, students are also taught phonemic spelling - of phonics. This means that they learn to read and write by recognizing different "phonemes," or letter-sounds.

This "sound-it-out" approach enables students to grasp the connection between spoken words and written words more easily, since it eliminates the confusion caused by the many spelling inconsistencies of the English language.

Students who use this method when writing learn to choose the "best word" - not just settle for one they know how to spell. And this helps them achieve higher word recognition more quickly.

The Literacy Program offers a proven approach to teaching reading skills. And now, with the added presentation power of the IBM InfoWindow system, this approach can be even more dramatic.

An InfoWindow system includes several hardware components:

- An IBM Personal Computer and keyboard
- An IBM InfoWindow Display
- A non-IBM videodisc player

This configuration combines the power of an IBM Personal Computer with vivid graphics, pictures and audio from a videodisc player to make presentations more active, more involving. What's more, it enables students to learn ... study ... and review materials at their own pace.

The alphabetic principle, phonemic learning method and InfoWindow technology come together in the learning center. This on-site learning facility provides an interactive, individualized environment for up to 16 students at a time.

The structured learning environment is managed by a classroom administrator. Students split the one-hour-per-day class by working in pairs at the IBM InfoWindow system on reading and work journal exercises. Then, the students work individually at PC typing stations developing typing and writing skills.

Depending upon a student's proficiency -- and based upon the suggested one-hour-per-day class sessions -- the course should be completed in one semester or approximately 20 weeks.

The Literacy Program and InfoWindow provide organizations and institutions with a revolutionary solution for one of today's most pressing problems.

MERGING OF OFFICE AUTOMATION AND INFORMATION SERVICES

Terry K. Hippenhammer

The Eugene School District is located in Eugene, a city of 105,000 and home of the University of Oregon. The district has four high schools, eight middle schools and twenty-four elementary schools, with 17,500 students and 2,000 employees. The school district is committed to providing computing solutions through a distributed network.

Background

The Superintendent decided in early 1985 that a new management structure was required to pursue effectively the district's information systems objectives. To that end, the Director of Computing and Information Services was hired in July, 1985 and was included on the Superintendent's Staff. This placed the computing and information needs of the district at the highest level of visibility. The Superintendent's Staff is a cohesive management team that meets weekly to deal with district management concerns. A computing policy committee meets monthly to recommend information system policy, plans, and priorities.

The structure of a school district can be likened to American corporate structure with a corporate headquarters (Education Center) and branch entities (elementary, middle, and high schools). Information flow to and from corporate and geographically dispersed branch entities must occur in a timely fashion. When the timeliness and accuracy of this information flow is increased, the organization's ability to respond quickly to the changing needs of its constituency is enhanced.

The Eugene School District consists of several administrative departments in the Education Center and four school feeder systems (each with one high school, two middle schools, and six elementary schools). Information flow occurs in three primary ways: 1) to/from Education Center and school, 2) within the feeder system, and 3) across organizational lines (e.g., school level committees--middle school principals, athletic directors, etc.).

The Concept

Merging office automation and information processing technologies hold out promise for tremendous new savings and benefits to the operational and management requirements of the school district. By emphasizing network solutions, the district intends to apply the latest technologies to implement systems that will be viable through the end of the century. The All-In-1 office automation system is being used as the foundation for implementing information systems. A district designed All In-1 menu provides a single window on all applications (whether office automation or information systems). Access to network services is

provided through a single workstation on each desk (VT220 terminals, VAXmates, and Rainbows PCs) with the Gold Key office automation keyboard.

The district has begun implementing its plan of applying technologies for optimal movement of information flow across the organizational structure. The key management goal is to maximize accuracy and timeliness of information while reducing paper in the work place. This will most likely occur when information systems and office automation tools are presented to the end user as an integrated set of solutions.

District management believes that the system architecture which best serves this goal will be built around a network of distributed computers. A VAX 8650 located at the Education Center provides districtwide office automation and application software. The network provides access to off-network services including a direct link to the Lane County Education Service District's IBM mainframe where financial and student systems are provided. This link allows uploading and downloading to provide integration of district data bases with office automation tools and to provide much needed online services.

When cost/beneficial, additional VAXes may be added to the network to provide discrete services (i.e. Videotex, instructional support, etc). These may include VAXes at high schools to provide local office automation, instructional, and/or other application needs for the high school and its feeder school system. Plans are underway to pilot a VAX at one of the district high schools in the Fall of 1987.

Progress to Date

Rapid expansion has occurred since the VAX 11/780 was installed in the Spring of 1985. The Superintendent and the nine members of the Superintendent's Staff were among the first to have VT220s and are key users of the system. Use of electronic mail by the Superintendent and her staff, motivates use of network services by other administrators. After a recent thunder storm disrupted service for some users, David Mortimore, Director of Elementary Education, remarked, "I can't believe how affected I am when the computer is down. Through the VAX, I can communicate in 5 minutes effort what used to take 24 phone calls."

During the period of July 1985 through June 1987, workstations on the network have increased from 8 to 227 while the number of users has climbed to over 400. All schools and administrative facilities have workstations on the network. Existing and planned workstations are listed below:

	installed base	planned total (per school)
o Education Center	116	122
o Board Members	7	7

o	High Schools	27	84 (21)
o	Middle Schools	31	80 (10)
o	Elem Schools	46	72 (3)
o	Total	227	365

Laser printers are installed in major departments of the Education Center, at each high school, and some middle schools. All other locations have letter quality printers. These printers are used as "shared" printers at each school and within the Education Center. In some cases, they are used to print reports or flyers directly at the schools, thus reducing the need for centralized printing, stapling, and mailing at the Education Center.

To handle the increased load, the VAX 11/780 was upgraded to a VAX 11/785 in early March 1986 and upgraded again to a VAX 8650 in November 1986. DECnet ethernet with nineteen DECserver 100s was installed to provide access to the network for all Education Center and secondary school users. The secondary schools gain access to DECnet DECserver 100s through use of Paradyne 2030 multiplexers and 9600 baud leased lines. The elementary schools and remote administrative facilities gain access through dialup 1200 baud modems.

A number of in-house developed applications have been integrated into All-In-1. Office automation tools and information systems are implemented together as interrelated services for the schools.

A professional office automation specialist on staff provides training in all services provided. In-service classes and one-on-one training are provided. While classes in specific subjects such as WPS-Plus word processing and DECalc spreadsheets are offered, training for office automation and informations systems has been merged in others. One such class for school secretaries provides training on general All-In-1 concepts, electronic mail, and the online warehouse system.

Automated office services are being expanded to include Videotex applications. The curricular scope-and-sequence documents and the district policy manual are being converted to Videotex and will be made available to subscribers via the All-In-1 menu.

The seven members of the School Board of Directors have VT220 terminals installed in their homes with dial-up access to the network. According to Dr. Margaret Nichols, Superintendent, "The VAX system has opened a new world of communication, information, and convenience." She indicated that, "perhaps the most valuable aspect of our system has been the installation of terminals in the homes of each of our school board members. The ability to communicate with school board members as quickly and conveniently as we can communicate with staff has opened new dimensions of understanding and awareness for the board. It allowed me to have

a clearer sense of what kinds of information they need, and provided all of us with the opportunity to ask and answer questions informally which would not have been asked or answered in a board meeting. Board members are careful never to violate Oregon laws by using the system to deliberate toward a decision or communicate public information, but they and the staff have found that we can provide additional information at meetings much more effectively when we know what is needed, can answer small but important questions quickly, and give the board some of the "news" about the district which was too time consuming to disseminate routinely before we had electronic mail."

Dr. Nichols said, "I have come to value the word processing component of the system a great deal also. I now compose all my correspondence, speeches, and articles using the VAX, which gives me the capability of editing with the greatest ease." The Superintendent was interviewed for this paper via electronic mail. Her concluding statement was, "Even preparing this statement was no problem because I did it on the VAX!"

The Digital style of computing has been a tremendous asset for the district as we pursue ways to communicate more effectively and to provide appropriate, timely information to meet operational and management needs.

The following are trademarks of Digital Equipment Corporation:

VAX All-In-1	
VAX 11/780	WPS-Plus
VAX 11/785	DECalc
VAX 8650	DECnet
VT200	DECserver 100
VT220	LN03
Videotex	Rainbow

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CI^3: Integrating The Computer-as-Tool Into The Science Curriculum To Bring About Change

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Goals and Objectives of the CI^3 Project

The Computer-Integrated Instruction Inservice project (CI^3) directed by Dr. David Moursund, University of Oregon, is a three year project funded by the National Science Foundation. The purpose of the project is: (1) to develop an inservice model for educating teachers in methods of integrating general computer software tools, such as databases, spreadsheets, graphics programs, science tool kits, etc., into the existing curriculum and (2) to develop a method for training inservice trainers in the use of the CI^3 model (refer to Hanfling, Mathis, and McCauley 1986 for a detailed description of the model).

The CI^3 inservice model emphasizes the use of the teacher's knowledge and skills. The model creates an environment where teachers feel comfortable exploring and experimenting with various applications of computer software tools in the curriculum. This model contrasts with inservice training emphasizing a specific teaching technique, computer management skill, or the development of* competence with a specific piece of software.

The objectives of the CI^3 model are: (1) to motivate participants to examine their curriculum to determine if a computer application could help them teach in a more efficient or interesting way; (2) help participants identify new or complex concepts, currently not taught, that would be made feasible by using the computer-as-tool; (3) motivate teacher initiated peer support groups; and (4) increase the time teachers spend consciously sharing what they have learned with their colleagues (Hanfling, 1986).

The first year of the project (1985-86) concentrated on developing the inservice model and piloting materials in elementary and secondary school mathematics. The second year (1986-87) the

project focused on: (1) modifying the inservice model; (2) revising the first year's inservice materials and replicating the elementary and secondary school mathematics inservice; and (3) developing science materials and piloting the secondary science inservice. The final year (1987-88) the project will concentrate on: (1) revising the science materials and replicating the secondary science inservice; and (2) developing the social studies materials and piloting the social studies inservice.

Goals and Objectives of the Science Inservice

The ultimate goal of the CI^3 science project is to create change in the science classroom that leads to improvement in education. The first symptoms of the need for improvement in science education were: (1) decreasing enrollments in science classes and (2) declining scores on measures of student achievement and attitudes. In addition, reports such as A Nation At Risk and Educating Americans for the 21st Century further documented serious problems in science education.

The development of universal scientific literacy for all citizens is an important goal for science educators. Miller (1984) states that "like it or not, science constitutes a significant part of our culture, for science determines, in numerous and profound ways, how we understand the world, how we assess situations, and how we act. Even when science is not well understood, or even when it is only manifested in a technology which is used in our work or play, the effects are still significant" (p. 403).

Linn (1987) supports Miller by indicating that "the quality of science training received from the preschool years on affects how well citizens understand their increasingly complex world and how effectively they cope with change. The explosion of new technologies and new information has challenged science educators to revise traditional approaches and set new priorities" (p. 191). Further, Linn believes that the challenge has not been satisfactorily met. CI^3 inservice materials utilize integrated computer tools as one method to bring about changes in science curriculum and instruction.

CI^3 science activities were designed to satisfy the following requirements: (1) provide practice in a basic set of "science skills"; (2) reflect current research describing the nature of the learner; and (3) emphasize a process approach to science education.

Members of the development team (see Note 1.) identified a preliminary set of science skills required by students to achieve success in the science classroom. The initial set of skills reflected the combined personal experiences of four science teachers. Two sets of CI^3 inservice participants provided feedback that supported the accuracy of the original list. CI^3 activities are designed to provide practice in one or more of the following skills: (1) data collection; (2) data organization; (3) interpretation of data; (4) presentation of data in different formats, such as charts and graphs; (5) communication of student ideas and experimental results; (6) model cooperative learning; and (7) a process or inquiry approach to science education.

In addition, CI^3 materials incorporate the view of the learner as an active constructor of knowledge. Linn (1987) states that "there is widespread agreement that learners actively construct an individual worldview based upon personal observation and experience and that they respond to formal instruction in terms of this preexisting intuitive perspective" (p. 195). Further, "the experiences and observations of learners in different populations and cultural groups may lead to distinct world views that manifest themselves in diverse responses to science instruction" (p. 195).

Each of the eight inservice sessions demonstrates integrated computer applications, such as databases, spreadsheets, word processing, and graphing. The software tools are used in a manner that empowers student communication, encourages hypothesis generation, and facilitates presentation and evaluation of data.

Discussion of CI^3 Database Activity

For example, the fish database activity was developed to encourage hypothesis generation and provide practice in data

organization. The database contains information on 6 characteristics (fields) for 18 types of fish. Inservice participants examine the database looking for relationships between different characteristics. Discovery of relationships is facilitated by using the computer to reorganize fields and sort data. Characteristics that suggest possible relationships are transformed into computer generated graphs that allow participants to evaluate the questions, relationships, or hypotheses they generate.

Skills emphasized in this activity are data organization and interpretation of data presented in two forms: a table and a graph. Computers remove barriers that frequently prevent intensive practice of these skills in the traditional classroom setting. For example, the computer enables students to work with larger collections of data than is normally found in science textbook activities or traditional laboratory exercises. Further, the reorganization and sorting capabilities of the computer encourage teachers to require that students manipulate these larger data sets without placing unreasonable demands on the students. Computerized graphing, replaces the labor intensive and time consuming student generated graph. This provides teachers with additional classtime to allow students to practice interpretation of data presented in different formats.

Traditional laboratory work emphasize the student as an hypothesis tester. Gale observes this frequently results in "a lab full of intelligent, interested kids, following a cookbook in order to bake something which hardly ever turns out. That is, the results are unpalatable. So, like good cooks, when the result is unpalatable, we season to taste-adjusting our results to fit what we know they are *supposed* to be" (cited in Speece, 1984, p. 56). Traditional laboratory activities make it difficult if not impossible for the students to be active constructors of knowledge. CI^3 science activities model an alternative that emphasizes the student as an hypothesis generator.

Computerized databases are one example of how an integrated computer application can lead to changes in instructional strategies and materials. Integrated applications allow science teachers to continuously modify activities to reflect the learners' previous

experiences. Unlike the static examples in a textbook, databases allow educators to incorporate the current interests of the learners. Computerized databases enable science teachers to use the large data sets students require to work on problems reflecting the complex nature of our society rather than cookbook examples.

Summary

Members of the project are aware of the enormous time required to develop databases and corresponding activities. However, commercial databases, that reduce the teacher work load, are increasingly available. These, coupled with cooperative efforts among teachers, can produce the valuable database resources required to bring about change in the science classroom.

One specific database activity has been discussed to illustrate the philosophy and goals of the CI^3 science project. Similar activities using word processing, spreadsheets, and graphing capabilities were developed by the project and demonstrated during each of the eight two hour inservice sessions.

The CI^3 science inservice materials provide a model of one method to bring about change in science education using integrated computer applications. The inservice model and materials provide science educators an opportunity to alter current curriculum content and instructional practices in several important ways:

- increases time allocated to hypothesis generation
- allows students to work with realistically large databases
- decrease the time students spend on mechanical activities thus increasing the time available for a process approach to science.
- nurtures students as active constructors of knowledge
- encourages scientific literacy

These should enable students to participate more fully in an increasingly complex technological society.

Note 1: Research Assistant CI^3 Project, Head of Science Develpment:
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Members of Science Development Team:
Lenore Davis-Woods
Lloyd Meskimen
Julie Poage

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USING COMPUTERS IN COLLEGE MATHEMATICS COURSES

Richard M. Koch

I was supposed to arrive at the Conference with a clear position on the place of computers in mathematics courses. However, the whole area seems murky to me. I'm going to show you some examples of software (maybe not even the best examples), talk about how the software could be used, and complain that it isn't adequate.

Some of this material may be useful for high school teachers, but I don't know beans about teaching high school. We'll assume that the students are smarter than we are and that the only thing we know about teaching unmotivated students is that we can't.

Let's start with *muMath*. It is a symbolic mathematics program written by David Stoutemyer and Albert Rich of the Soft Warehouse in Honolulu, Hawaii and is available for the Apple II, for CPM machines, and for the IBM. *muMath* is not available for my favorite computer, the Macintosh. The program has been used since the Dark Ages (1979). *muMath* was not written for educators, but it has obvious educational implications.

muMath can differentiate and integrate symbolically. For example, the command

```
DIF((x^3 + 1)^3 + sin(x^2), x)
```

(which means "differentiate the given expression with respect to the variable x") yields

```
(x^3 + 1)^2  3 x^2 + 2 x cos(x^2)
```

and the similar integration command

```
INT(x^2 + x SIN(x^2), x)
```

yields

```
x^3/3 - (COS (x^2))/2.
```

It comes as a shock to discover that microcomputers know how to integrate by parts and by substitution, but *muMath* isn't that hot at integration; it's about a B- student. The program is better at differentiation; lecturers at the University of Maryland gave it their first calculus midterm and *muMath* got an A.

muMath has many more capabilities; it can perform algebraic simplifications, can solve trigonometric equations, and can calculate Taylor polynomials. The wonderful thing about the program is that it is built on top of what is essentially Lisp and this language is available to the user. Thus it is possible to write computer programs which use the symbolic capabilities of the language; for example, you can write your own differential equation solver. *muMath* has the ability to display the source code for its programs. If you wonder, for example, how *muMath* differentiates, you can type GETD(DIF) and the computer will tell you.

How will *muMath* affect education, say in algebra and calculus courses? That is unclear. When the

program first appeared, a lot of nonsense was written about using the program to help poor students. For instance, some people suggested that students could use the computer to check their algebra. The trouble with this suggestion is that *muMath* does not write formulas in standard algebraic notation and does not always simplify in the expected manner (there are flags which users can set to specify the method to be used for simplification). Thus you have to know a fair amount of algebra to determine if your answer agrees with the computer's answer. My impression is that *muMath* is almost useless unless the student is very good. Incidentally, a number of programs are available which *do* use standard algebraic notation.

muMath is sometimes used as an argument against teaching the mechanics of mathematics. "Why spend all that time factoring polynomials; computers can now do that," I've been told. Just last month the chairman of the mathematics department at Oregon suggested that we revise our calculus course to make much more use of computers and eliminate a lot of the material on trigonometric substitution and partial fractions; the extra time would be spent on applications and story problems.

I am dubious. Students I know do not have trouble with the mechanics of calculus. Even my C students can differentiate. The best students build on top of this an understanding of the real meaning of the subject. One of my jobs at Oregon is to place students in calculus courses. Here is a typical conversation:

> "Can you find the area between x^2 and x^3?"
>
> "It has something to do with integration but I have forgotten how it works."
>
> "What is $\int x \sin x \, dx$?"
>
> "Write u = x and dv = sin x and ..."

One possible conclusion is that we are teaching the wrong things. A second conclusion I find more convincing is that students remember algorithms long after they forget ideas BUT that it is easy to recall ideas if the algorithms are already present to act as a foundation.

It is likely that computers will have far more influence on the best students than on the worst. So I want to give some examples of computers used to explain subtle points for our best students.

Fourier Series

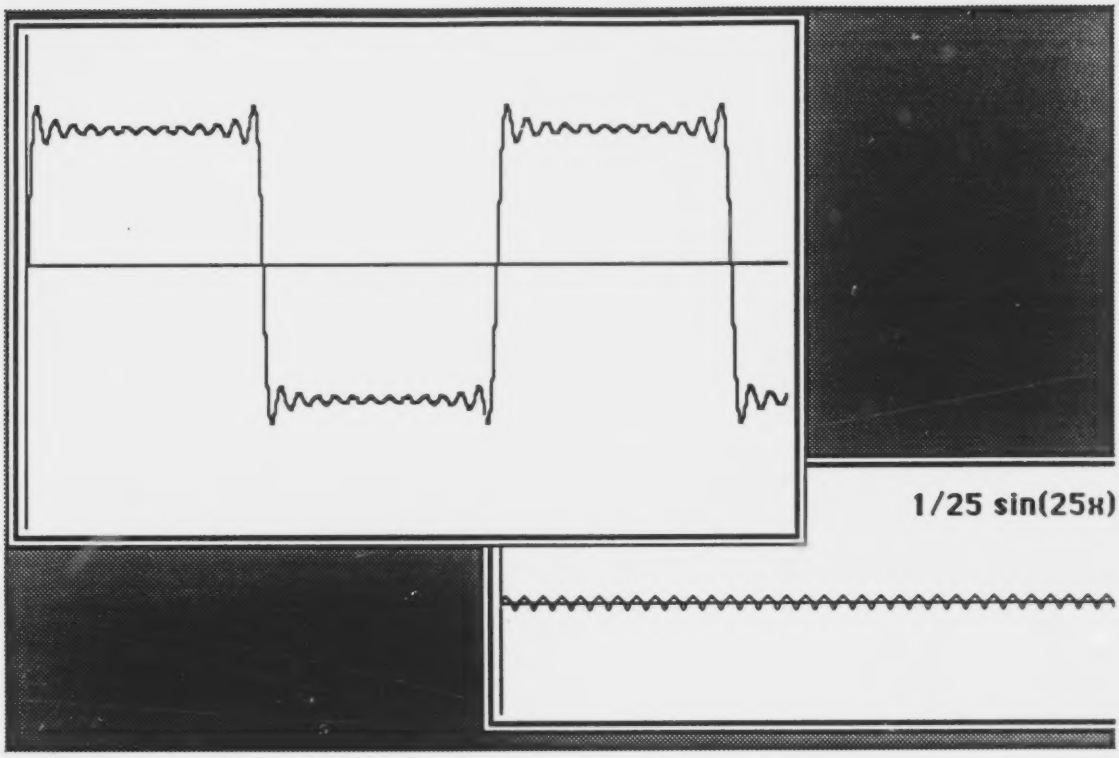
When Cauchy wrote the first rigorous book on the calculus in the early 1800's, he included a theorem which mathematicians in the know realized was intended to destroy arguments of Fourier:

> "If $f_1(x)$, $f_2(x)$, ... are continuous functions and $f(x) = \Sigma f_k(x)$, then f(x) is also continuous."

This theorem is, however, not correct. For example, the square wave can be written as

$$\sin(x) + \sin(3x)/3 + \sin(5x)/5 + \ldots$$

It is a simple matter to write a program which continually adds more terms of the above Fourier series, displaying the partial sums on a screen.



As you see, the sum of the continuous functions sin(kx) approaches the discontinuous square wave function in the limit.

The above picture shows more. Just before each jump at the discontinuities of f(x), the partial sums make a extra leap upward of about 10% of the jump value. As more and more terms are added in, this little leap gets closer and closer to the discontinuitiy (so that in the limit it disappears), but the leap turns out to always have about the same value, 10 to 11 percent of the jump. This feature of partial sums of Fourier series is called the Gibbs phenomenon because it was first discovered by the Yale physicist Williard Gibbs, who calculated the partial sums *by hand!* Later on, mathematicians proved that the phenomenon is a general feature of Fourier series.

The Gibbs phenomenon shows an interplay between calculational (or experimental) mathematics and theoretical mathematics. Such examples are scattered throughout mathematics, and we do our students a disservice when we ignore them. The day will come when mathematics lecture halls contain large computer displays and mathematics lectures are filled with experiments as routinely as today's physics lectures contain them.

Number Theory

To my mind, the most successful recent use of computers in mathematics education is in connection with number theory. Computers have been used since they first became available to do numerical experiments, of course, but most of these experiments have not had a high reputation among professional mathematicians. But recently it has become possible to do numerical experiments which

are directly connected to the most fundamental facts of number theory. The program *muMath* can deal with integers up to 600 digits long; it can add, subtract, multiply, and divide such integers very **rapidly**. Other programs for dealing with large integers are available from Reed College and from other sources.

Consider some examples. Let p be a prime and consider the set $Z_p = \{0, 1, 2, \ldots, p - 1\}$. It is possible to add, subtract, and multiply numbers in this set: "operate as usual; if you get too large an answer, divide by p and take the remainder." For example, let p = 7. Then 4 + 5 = 9 = 7 + 2 = 2 and 4*5 = 20 = 2*7 + 6 = 6.

Remarkably enough, you can also divide in Z_p. For example, in Z_7 the number 1/3 is that unique number which when multiplied by 3 gives 1. Notice that 5 has this property because 3*5 = 15 = 2*7 + 1 = 1, so 1/3 = 5. The proof that such a number always exists is very interesting because it does not show how to actually find the number. Here is the proof. Fix a number $a \neq 0$ in Z_p. Define a map from Z_p to Z_p by x Æ ax. Notice that if ax = ay then x = y because you can cancel (here we use the fact that p is prime). So our map takes distinct elements to distinct elements. But in mathematics there is a famous principle called the pigeon hole principle: if N pigeons are placed into N boxes and each box gets at most one pigeon then each box gets a pigeon. So ax = 1 for some x. Done!

Now suppose that p is very large, say $2^{101} - 1$. To find the number 1/3 in Z_p, we theoretically have to go winging through all of the numbers from 1 to $2^{101} - 1$ until we find one which when multiplied by three gives one. This is completely impossible in a practical sense, even if we have the world's largest computer and all the time in the world.

Luckily, there is another way to do it. Early in a number theory course, most students will learn the Euclidean algorithm. This algorithm can easily be extended to prove that if A and B are relatively prime, then X and Y exist so that A*X + B*Y = 1. Moreover, the algorithm shows how to calculate X and Y. Suppose now that $a \neq 0$ in Z_p. Then a and p are relatively prime and the Euclidean algorithm gives X and Y with a*X + p*Y = 1. But in Z_p this equation reads a*X = 1.

It is great fun to see this calculation on a computer. *muMath* can find the inverse of an integer extremely rapidly even if p is a twenty or thirty digit prime.

The first really deep theorem of a modern number theory course is Fermat's result that $a^{p-1} = 1$ for each $a \neq 0$ in Z_p. I learned this early in my college career but sadly did not learn until after my PhD that the result has practical implications. Suppose you have *guessed* that p is a prime number. Choose any a; 2 and 3 are reasonable choices. If a^{p-1} is *not* 1 in Z_p, then p is definitely not prime. If $a^{p-1} = 1$, the chances are good that p is prime; these chances can be considerably improved by minor modifications I will not describe now.

At first you might guess that it would be extremely impractical to calculate a^{p-1} if p is a twenty digit number. But two tricks make this calculation feasible. First of all, at each intermediate stage in the calculation you should divide answers by p and only keep remainders. And second, you should calculate the power by doing successive squaring operations. For example, a^8 can be calculated with only three multiplies by writing $((a^2)^2)^2$.

Fermat's theorem has a very different feel about it as soon as you have seen it used on a computer. There are many additional spots in number theory - the law of quadratic reciprocity, the study of rational points on a quadratic curve - where computer experiments occur naturally in connection with the very deepest part of the theory.

High Powered Machines

We mathematicians have been proud that our profession requires only a blackboard and chalk or a pencil. This is an unfortunately thing - all the great toys go to someone else.

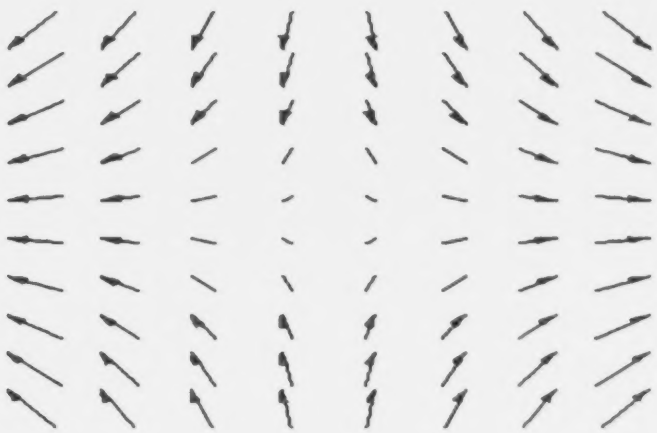
However, the situation is completely different when we come to study mathematical uses of computers. Mathematics is a symbolic subject and it is also a very geometrical subject. The subject requires the use of computers with powerful graphic capabilities. But such computers are expensive; they are only now becoming available for the general mathematical community. That is why mathematicians are among the last disciplines in the University to use computers. I'd like to end by showing three uses of these powerful graphic computers.

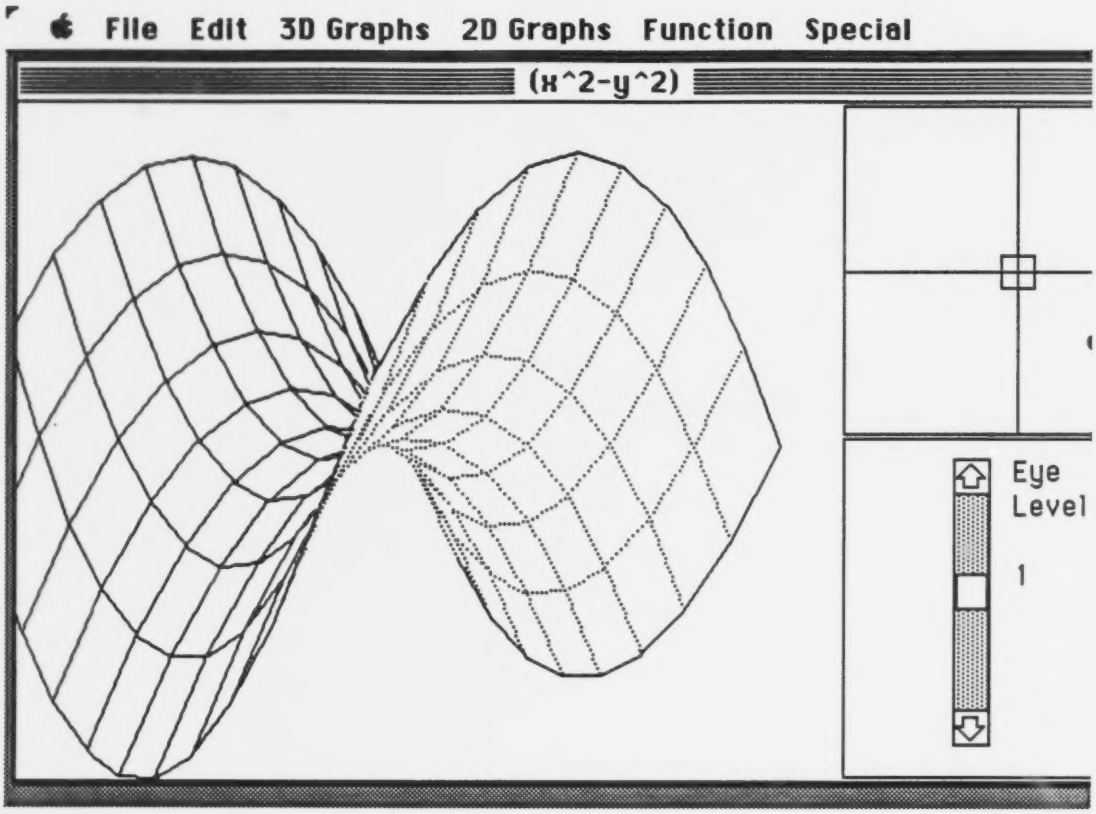
One use involves high resolution color to study the Mandelbrot set,the theory of iterative processes, and phase space portraits of differential equations. This paper will be printed in black and white, so I will leave that application to the Conference session.

In second year calculus, we study surfaces in two dimensions. These surfaces are notoriously difficult to draw, and most instructors get by with one or two saddles and a parabaloid. There have been recent articles in the American Mathematics Monthly complaining that almost all the pictures in calculus books are wrong! Surely computer help is needed.

Recently a public domain Macintosh program appeared which can draw such surfaces. For me the program had a very romantic name: Math 21. That is the name of the second year calculus course at Harvard where I was a student; the program almost smells of chalk dust to me.

Math21 allows students to input a function of two variables written in the standard way. Things like $\sin(xy)$ and $x^3y + 3x$ are legal. Below are two screen dumps from the program. In the conference we will discover that graphing is quite slow; clearly we mathematicians need at least a Macintosh II for our work.

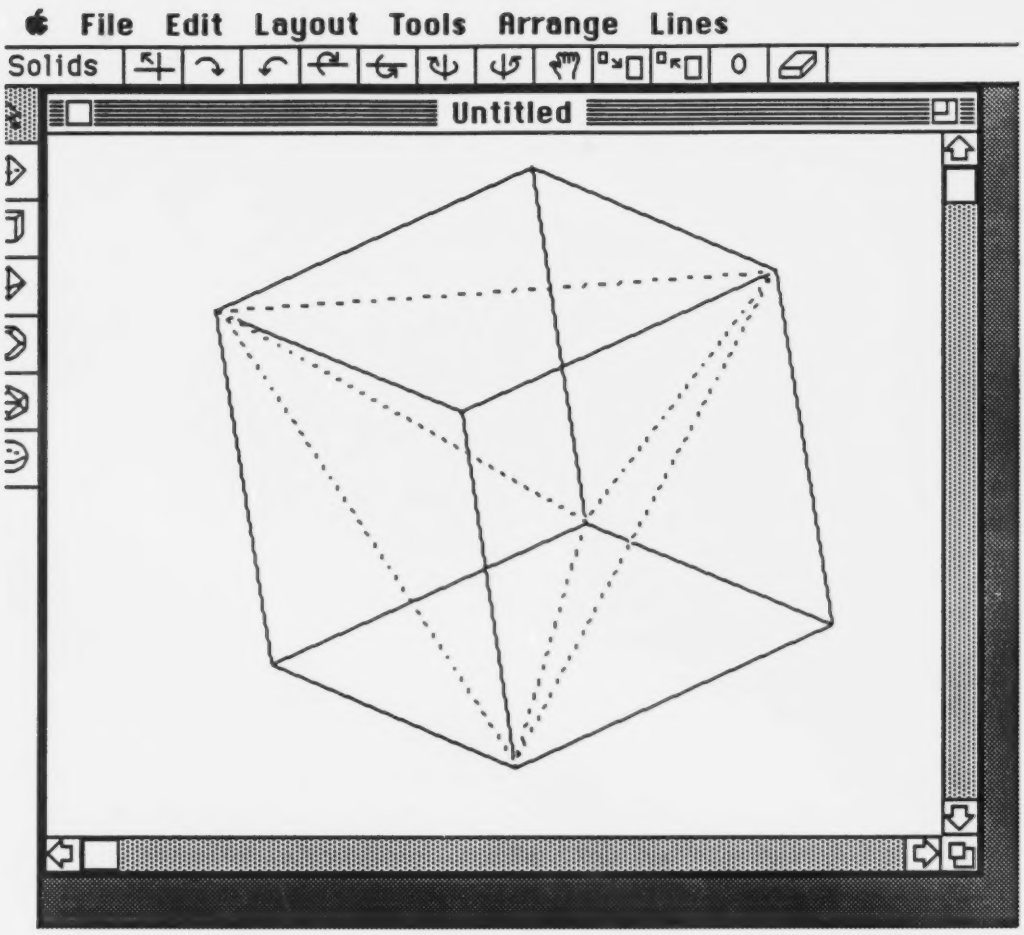




Math21 is one of a growing number of Macintosh programs written to illustrate mathematical ideas. Most of these programs, while exciting, are buggy and have unusual interfaces that make them hard to use. It is often the case that once embarked upon a calculation the programs will not let you interrupt until the calculation is finished, and they have a number of other features that would never be tolerated in a commercial application. I'll show several examples at the Conference, at once exciting and frustrating.

3D Images

Surely you do not expect me to finish without describing my own recent work with Alan Hoffer. We are constructing a three dimensional geometry program for teachers. I prefer to let the program speak for itself and offer here only one screen snapshot as a teaser:


File Edit Layout Tools Arrange Lines
Solids
Untitled

THE INSTRUCTIONAL USES OF MICROCOMPUTERS IN THE STATE OF OREGON : THE SPRING 1987 ASSESSMENT OF THE OREGON ELEMENTARY SCHOOL!

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INTRODUCTION

Although more than 20 years have passed since the first computer was introduced in an elementary school in the United States (The National School Public Relations Association, 1968), only 1983 saw the first serious attempts at assessing the instructional uses of microcomputers in all American schools. Hence, in 1983 and then in 1985 appeared the findings of the two national surveys conducted by Dr.Henry Becker of the Center for Social Organization of Schools at John Hopkins University,and in which he attempted to assess the instructional uses of computers in both elementary and secondary schools. Looking only at a few of the highlights of this massive and most informative study, the 1985 survey when compared to the one conducted in 1983 revealed that,

a) the number of computers in use in schools quadrupled from about 250,000 to over one million, with the typical computer using elementary school having gone from two computers in use to six computers and the typical computer using secondary school going from five to 21 computers in use.

b) the proportion of elementary schools owning five or more computers went from 7% to 54%, while the proportion of secondary schools with 15 or more computers rose from about 10% to 56% !

c) three quarters of the schools which had not previously used computers began to do so, such that during 1984-1985 more than 15 million of the 46,000,000 students and 500,000 of the more than 2,500,000 teachers used computers for some educational purpose.

But looking more specifically at the instructional uses of microcomputers in elementary schools, the findings can be summarized as follows :

"Nationwide, the typical elementary school has 5 computers, each used about 22 hours per week by students under the supervision of a teacher or a staff member; out of an everage school population of 400, 150 students share these 110 hours which translates into 44 minutes per week for each of these 150 students ; in general, approximately 40% of all the instructional time is spent in having students interact with the computer via some drill and practice programs either in mathematics or language related subject, with 35% of the remaining time being spent having students copy, write or test computer programs, and the remaining balance being devoted to playing games."

During the same period, the State Department of Education of the State of Oregon conducted a simular but more modest survey of its 1228 schools, populated with

approximately 432,000 students and a teaching staff of over 24,000. Although regional and locational differences among schools exist, the survey yielded that Oregon did not differ significantly from the way the schools nationwide use microcomputers and the role they play in pre-college education. While the number of microcomputers in Oregon has grown tremendeously during the last two years (6,259 computers in the Fall of 1983 as compared to 14,554 by the end of 1985) Oregon educators preparing for the 1986-1987 schoolyear still found themselves plagued by the two main questions which to them had not been answered yet:

(1) Is this continued acquisition of microcomputer hardware and software COST-EFFECTIVE and JUSTIFIABLE in light of its expenditure,

(2) Is the instructional use of microcomputers EDUCATIONALLY EFFECTIVE when compared to the fruits of classical methodology.

It is the quest for the answers to those questions which formed the foundation of the survey. The data were collected through funds provided by the Oregon Computer Education Consortium, (OCCE), the Department of Education and the University of Oregon. The analysis of the data was supported by a grant from OCCE and students enrolled in the Division of Teacher Education of the University of Oregon.

METHOD

The Sample

The Oregon survey was conducted in May and June of 1987, and preceeded by a pilot study which was completed in the Eugene 4J School District, Eugene, Oregon in April of 1987. The schools selected for the survey were a stratified probability sample of 275 elementary schools, representing the 36 counties and the 100 Elementary School Districts in the State of Oregon. The sampling frame used for the study was the State Department of Education Data Bank of 940 Elementary Schools. Although the schools were selected at random, the number of participating schools for each county in the State of Oregon was proportional to the total number of schools in the State of Oregon and the total number of schools in the survey sample. Furthermore, schools were stratified according to school district size, whether they were urban or rural, the school population size and whether the school had a full-time, a part-time or no building computer coordinator. Only schools which had computers (97%) were considered for sample selection.

Source of the Survey Information

The principal of each school that was targeted to participate in the study received a package which contained three booklets. Information about the use of microcomputers in the elementary schools therefore was supplied by the principal, the primary computer using teacher (i.e. the computer coordinator or computer leader teacher) identified by the principal as the teacher most knowledgeable about how the computers were being used, and a regular computer-using classroom teacher of the school. Because of the length and detail of each questionnaire (a booklet containing either 25 or 42 questions)) and the desire to insure a reasonable and reliable return of the three booklets by each school, a variety of incentives for filling out the survey forms were provided. These incentives ranged from FREE PUBLIC DOMAIN SOFTWARE to all who participated, to a variety of PRIZES to be won by a few through a DRAWING.

Response Rate

On June 15, 1987, the deadline by which all questionnaires had to be returned, the response rate to the survey, including telephone follow-ups, was approximately 57%. Furthermore, data collected by that date included information from 157 principals (57%), 162 Primary Computer Using Teachers (58.5%) and 154 Regular Computer-Using Classroom Teachers (56%). Although more booklets were returned after June 15, 1987, the results presented here are based only on the information collected up to that date.

RESULTS

The survey was designed to gather information on five main issues:

a. Computer Use (when, how, why, where, benefit, drawback)
b. Computer Expenditures (hardware, software)
c. Computer Facilities and Location
d. Teacher Training
e. General Computer Issues

Because of the complexity and the size of the collected data, what follows then are the results which are deemed to be the most informative and of interest to both teachers and administrators in an elementary school. Furthermore, because of the sampling procedures the reported results may be interpreted as coming from a representative sample of all elementary schools in the State of Oregon.
In order to get some appreciation for the kind of school and student population this survey dealt with, it must be pointed out that the average full-time student enrollment in the participating schools was three hundred (300) students. Thirty Eight (38%) percent of these schools served children of factory or blue collar workers, while twenty nine (29%) percent of the school children came from about evenly mixed between white-collar and blue-collar families. Fifty four (54%) of

the schools reported that their students were not tracked and that those which were tracked, were tracked for only one or two subjects (32% of the sample). The average minority student representation in a school was 7%, while students enrollment in a talented and gifted program was approximately 4% of the school's population.

Are Elementary Schools in Oregon Well-Supplied With Computers and What are the Prevailing Models ?

Most elementary schools in Oregon acquired their first computer for instructional purposes in the early 1980's. Although a few schools deciding to introduce computers for instruction only in the 1986-1987 schoolyear, most schools had 8 computers in 1985 and average today twelve (12) of these machines for instructional purposes. The more affluent elementary schools in Oregon are even enjoying a maximum of fourty eight (48) microcomputers, which are mainly used for the 6th grade level and part of a middle school setting. While the majority of the schools use APPLE IIe computers for instruction, the Apple McIntoch and the IBM PC enjoy their popularity for the administrative tasks by both teachers and administrators.

What are the hardware Peripherals and What kind of Software is being used ?

The Computer-Using Teachers were asked to identify any hardware peripherals that their school's computers had and the type of software they had access to. Nearly 66% of these teachers reported that with regard to peripherals Joysticks or Paddles as well as graphics Pads or tablets were the most common. In addition to these, 31% of the teachers stated that they had voice-synthesizers, while approximately 10% reported that they had a modem or a hard disk drive available to them.
While the Apple IIe computer was the most popular computer used for either instructional purposes or for the completion of some of a teachers'administrative tasks (i.e. gradebook), the IBM PC and the McKintoch were the computers most used by the administrative staff of the school.
On the other hand, instructional software was obtained from sources which rated from the most frequently used source to the least, can be summarized as follows:

1. Commercial software,
2. Public Domain software,
3. Programs copied from other books or magazines,
4. Software written within the school system or obtained by exchanges with other schools
5. Programs teachers wrote and finally
6. Programs teachers or students copied from textbooks

Now, when teachers were asked who at their school, if anyone, had the opportunity to use or read the software PRIOR to its acquisition, their responses can be summarized as follows:

"BEFORE SOFTWARE IS ACQUIRED....."

a) The school's computer coordinator or primary computer teacher....
used...(92) read...(90) neither ...(12)

b) Another teacher who might use the program with students....
used...(85) read...(75) neither ...(15)

c) Another staff person or administrator at the school....
used...(34) read...(38) neither...(33)

d) A person from the school district office .....
used...(23) read ...(21) neither...(50)

Because teachers could check more than one response, the numeral displayed between parenthesis in the above table should be interpreted so as to give a "prevalent" response and hence a predominant practice.

Where are Computers Primarely Used and What are the Major Instructional Uses of Computers ?

Computers used for school instruction can be found in classrooms, laboratories, and libraries. The prevailing location where computers are being used however is the laboratory, where the average number of computers is eight (8). Few schools reported that computers were used in the classrooms, although where computers were found only one and then mainly accessable through a rotating schedule in the school was the majority rule.
In these laboratories, the most common way students work at any one computer at one time is either

a) two students per computer (39%), or
b) one student per computer, working on his/her own (33%), or
c) one student per computer, but with other students watching or helping (16%) or
d) more than two students per computer (12%).

When computers are being used, 65% of the schools report that students at the computers do the same assignment, while 35% state that students are doing different work. When the usage of computers in the classroom is compared to those in the computer laboratory, analysis of the data seems to indicate that laboratory computers are being used the most: their usage averages 21 hours per week, with a median number of minutes per week of computer use per student of 36 minutes.

When all participants were asked "What students are doing in their turns on the computer ?", the following responses were reported in terms of the highest frequency of responses to the lowest:

DOING DRILL ON FACTS OR SKILLS PREVIUOSLY TAUGHT.....(122)
GETTING DIRECT INSTRUCTION FROM A COMPUTER TUTORIAL.... (75)
WRITING OR EDITING TEXT..... (66)
USING ANOTHER TYPE OF PROGRAM..... (40)
WRITING COMPUTER PROGRAMS..... (28)

When on the other hand, the Primary Computer Using Teachers (i.e. coordinators) are asked what type of programs are generated on the computers in their school and what percent of all the students' use of computers were of that type since September 1986, the following chart can be presented :

TYPE OF PROGRAM	% OF STUDENT BODY USE
Drill and Practice on content or Higher skills Games to help students practice skills or concepts.	34%
Problem solving tasks and Simulations for learning or suing concepts and skills in a specific situation	29%
Tutorials	23%
Programs that require the use of	
WORD PROCESSORS	17%
DATA BASES	3%
SPREADSHEETS	1%
A programming language, like BASIC, LOGO or PASCAL for students to write programs to learn	2%
Programs that summarize data with graphs or statistics	1%

While students in these laboratories are supervised and helped by a variety of people, the listing below shows the most common practice :

Classroom teachers.....41%
School media specialist.....23%
A paid adult aide.....14%
Parent volonteers.....12%
Full-time Computer Coordinator.....4%
Other.....3%
A school Administrator.....1%
Advanced-level students.....1%

Looking now at what prevailing software is being used in the laboratory, it can be said that since the last three years programs related to the subject matter of mathematics and curriculum areas where the computer is primarely the OBJECT of INSTRUCTION rather than the MEANS OF INSTRUCTION are the most popular, while subjects such as spelling, writing, reading, and language arts which might benefit from activities using wordprocessing skills or the building of data basis constitute the computer activities are the second most commonly found computer generated subjects.
When asked how important the use of computers is or will soon become for improving student mastery of the material, primary computer-suing teachers responded in the following way :

For the Traditional Skill or Concept	For Mastery Computers are.....			
	Essential	Important	Helpful	Little Help
MATHEMATICS.....	17%	38%	43%	3%
LANGUAGE ARTS.....	12%	46%	37%	6%
SCIENCE.....	10%	16%	52%	22%
READING	6%	27%	51%	16%
SOCIAL STUDIES.....	6%	20%	64%	10%
SPELLING	4%	30%	57%	9%

However, the instructional programs with which students interact in an elementary classroom differs of course from grade level to grade level and in accordance to the teachers' point of view of the possible utility of the computer. Tabulation of the recorded responses related to such issue revealed that 53% of the computer using teachers held the belief that tasks generated by a computer should be reserved for enrichment activities rather than for regular instruction, while 35% of the same respondants felt that the computer should be used only as a remediation or a help for students behind their understanding or achievement in a subject matter, with the remaining 12% of the respondants believing that computers should be used in regular instruction or part of the regular delivery of instruction.... On the other hand, only 23% of the principals felt that when students have trouble understanding the material in their class, extra instruction should be given on the computer, while 66% felt that extra instruction should not be given on or with a computer at all...

At each participating school, the Primary Computer Using Teacher was asked when their school got its first instructional computer, whether the computer's most useful application was

a) as a method of improving student's basic skills in a subject area,
b) as a resource for students to learn more about computers, or
c) as a tool for students to accomplish an academic task-such as writing.

The responses were as follows : Fifty nine percent of the respondants felt that the first computer's most useful application was as a resource for students to learn more about computers; 36% felt that the computer was a method for improving a students basic skills, and only 5% felt that the computer was a tool for students to accomplish an academic task. Today, 35% of these same respondants feel that the computer is a tool, while 38% of them concur that the computer's most useful application is as a method for the improvement of basic skills and 17% as a resource for students to learn more about computers.

What are the Outcomes of Using Computers in a School ?

Both principals and primary computer-using teachers (i.e. PUCTs) answered a set of questions. The questions were about their perceptions on how computers have affected instruction and learning at their school. They indicated whether "as a result of computers" there had been any improvement (or much improvement) in such areas as student enthusiasm, peer helping, individualized assignments, diagnoses of learning problems, and learning in regular school subjects by "above average", "average" and "below average" students. As most teachers do believe that they and their principals hold different standards for whether or not educational practice has improved in light of different practices, the data collected did show substantial differences in judgment about the outcomes, although both closely did agree on a variety of topics. The analyses of the data therefore reflects the percentages of both the principals and the PCUTs who indicated their perceived outcomes and is presented in Table I.

TABLE I

PRINCIPALS' and PCUTs' PERCEPTIONS OF COMPUTER IMPACT.

Outcome At the School	As a Result of Computers.... "Much More"		"Some More"		"Same as Before"	
	PCUT	PRIN.	PCUT	PRIN.	PCUT	PRIN.
Enthusisam of students for school in general.....	40	44	44	48	15	8
Special opportunities for the academically gifted.....	32	27	51	63	17	11
Special opportunities for the learning disabled.....	31	28	54	58	15	14
Students working independently without direct supervision...	29	17	56	71	15	12
Students helping other students with their questions.....	26	16	45	50	29	33
Learning in regular school subjects by below-average students.....	20	17	62	65	18	18
Learning in regular school subjects by average students.....	14	12	66	61	20	28
Students assignments tailored to individual needs.....	12	15	47	57	41	28
Learning in regular school subjects by above-average students.....	11	11	68	66	21	23
Diagnoses of students' learning problems or misunderstanding.....	6	6	29	39	65	55

Looking at the above results, principals and primary computer-using teachers see two areas as most affected: student enthusiasm for the subjects for which they use computers and special opportunities for the academically talented or for students with learning disabilities or handicaps.

In this survey both principals and primary computer-using teachers were also asked for which of the outcomes have computers caused the most improvement. Not

surprisingly, the answers of the principals and the PCUTs from the same school were "enthusiasm for school" and "special opportunities for students with handicaps". On the other hand the outcomes with the least perceived improvement due to computers were diagnoses of student's learning problems or misunderstanding and learning in regular subjects by above-average students. To give additional insight into the advantages that teachers might see in the use of computers for instruction, the primary computer-using teachers were asked to state what the three most important advantages of the computer was for their students. Seven advantages were given and TABLE II summarizes the responses. The advantages are rated from the one which received the greatest number of endorsements to the the one receiving the least.

TABLE II
ADVANTAGES OF COMPUTER USAGE

ADVANTAGE	RATING
They get immediate feedback about whether they are right or wrong.....	#1
It makes learning more enjoyable.....	#2
Computer-based instructions can be varied for each individual student.....	#3
They learn about things they otherwise would not be exposed to.....	#4
The computer is a challenging focus for the faster-learning students.....	#5
Slower-learning students can progress faster than they would otherwise.....	#6
Students learn things more quickly.....	#7

But besides asking PCUTs and principals to respond to specific ways that the computer might have affected the learning and the teaching process at their school, the regular classroom using teacher was asked how his/her teaching of the subject in which they used computers the most, changed since they began using computers. Six types of activities (benefits) were identified and teachers were supposed to acknowledge whether compared to before, they did it more often, less often or about the same as before they began using computers with the subject. Here below now follow their responses in table III.

TABLE III

EFFECTS OF COMPUTER USE ON TEACHING AND LEARNING

	Compared to Before			If "MORE" or "LESS" Computer-Related	
Activity	About Same	More Often	Less Often	Yes	No not Related
Group for Instruction: teach part of a class at one time.....	72	21(*)	7	(*)YES	
Have students do individual work at their seats	77	8	15(*)		(*)NO
Use whole-class activities....	71	18(*)	11	(*)YES	
Have students tutor and help each other.....	51	46(*)	3	(*)YES	
Talk with students' parents.....	20	68(*)	12	(*)YES	
Work evening and week-ends preparing to teach the subject.....	73	18(*)	9		(*)NO

As can be noted from the table above, the majority of the computer-using teachers when asked about changes in their teaching methods since they began using computers, found no perceivable effect attributable to their use of computers. When changes were reported, teachers found that these changes were not attributed to computers.

Primary computer-using teachers were also asked to compare the quality of instruction that Computer Assisted Learning provides with a more traditional approach that they might use and to state which method to them is better. Table IV summarizes these teachers responses in reference to six pedagogical issues.

TABLE IV
PERCENTAGE OF RESPONSES ON PEDAGOGICAL ISSUES

In terms of.....	Which method is BETTER ?		
	Computer	Traditional	Same
Introducing students to the subject.....	8%	77%	15%
Presenting a variety of examples of concepts.....	41%	36%	22%
Measuring how well a student understands.....	21%	50%	29%
Correcting a student's lack of understanding.....	27%	51%	22%
Rapidly covering the material.....	53%	34%	13%
Teaching to students of different abilities.....	53%	30%	17%

What are the Perceived Effects of Selected Software Usage on Teaching Methods ?

In order to obtain additional information about the use of computers in schools, primary computer-using teachers were asked for the perceived effectiveness of their selected software. One of these questions asked "When compared to other methods that teachers use to teach skills or concepts, how effective is software in terms of

a) Student effort,
b) Student enjoyment while working
c) Classroom management,
d) How well average students learn the material,
e) How well above-average students learn,
f) How well below-average students learn"....

Table V summarizes the results of this analysis.

TABLE V

EFFECTIVENESS OF SELECTED SOFTWARE

How Effective In Terms of.....	Compared to Other Methods You've Used, How Good is Software ?			
	Much Better	better	Same	Worse
(b)	37%	53%	9%	1%
(a)	22%	54%	20%	4%
(e)	15%	46%	37%	2%
(f)	14%	49%	35%	3%
(c)	9%	14%	65%	12%
(d)	7%	36%	55%	2%

While the effects of computer usage must be related to the used software, all computer-using teachers were asked a variety of questions related to software. On the other hand, as in some schools some software might have been available but might not have been used. Hence, the respondants were asked if in their school some software was not being used, what might have been in their opinion the major reasons that that software was not being used. Table VI below gives the percentages of those responding to the six identified reasons in the survey.

TABLE VI

WASTE OF SOFTWARE

REASONS	PERCENT OF RESPONDANTS AGREEING
No one has the time to investigate whether the programs are useful.....	98%
Poorly written software.....	93%
The software is O.K., but is no better than other methods that I prefer.....	57%
The Software is useful, but not in a classroom or school setting.....	20%
Another reason.....	17%

The software has been superceded by
better products..... 10%

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The most prevailing response to the reasons why some software wasn't being used in a school was that teachers just didn't have the available spare time to evaluate and review either the appropriateness or the possible educational benefit of the unused programs. Matter of fact, telephone interviews with teachers selected at random, strongly reinforced that view held by the majority of the participants in this survey.
Finally, to conclude the questions on software, classroom teachers were asked whether as a result of using computer software the time they devoted to subject matter, skills or concepts increased, decreased or stayed about the same. In light of the already know perceptions held by teachers on the use of computers for instruction, it wasn't a surprise to learn that 81% of those teachers responded that that time remained the same.

How Did Teachers Respond To Some General Issues About Computer Usage ?

Many teachers have expreseed reservations about schools buying and using computers for instruction. Therefore, the survey included two questions which both the principals and the primary computer-using teacher were asked to answer.
The first question asked what kind of reservations they had heard most often from other teachers. Ranked from the most often heard to the least, the chart below displays these reservations :

There is not enough time to fit computers in.....#1

The school has too few computers for students
to get enough time to learn.....#2

I have not heard any reservations about
computers at this school.....#3

Teaching programming is not that important
for children of this age.....#4

The computer programs cost too much in
the quantity we need.....#5

There are better ways to provide instruction
than using computers.....#6

The second question asked these respondants which problem's solutions would most improve their school's use of computers for instruction if only three of the problems listed below could be solved by their school.

Their responses in terms of the most frequent acknowledged solution to the least, is displayed in TABLE VII below.

TABLE VII

PROBLEM	RATING
Not enough computers to go around.....	#1
No time to develop enough useful computer-based activities.....	#2
Teachers lack interest in learning about computers.....	#3
Not enough money to train teachers about computers.....	#4
Hard to locate or evaluate the software that has been written.... Too costly to buy enough copies of software to go around.....	#5
Software not yet written for many topics that must be taught.....	#6

As a conclusion to this section of the survey, classroom teachers were asked to respond about the problems that they perceived in reference to the use of microcomputers in their school. Five statements were presented and they were asked to describe their opinion through an acknowledgment on a Leikert scale displaying " AGREE", "TEND TO AGREE", "TEND TO DISAGREE" or "DISAGREE" with the statement. TABLE VIII summarizes the percentage of responses per category.

TABLE VIII

PROBLEM	YOUR OWN OPINION			
At Your School.....	Agree	Tend Agree	Tend Disagree	Disagree
Most decisions about how our school's computers will be used are made by one or two people.....	26%	27%	17%	30%
Computers facilities are being used less than would have been expected a year ago.....	9%	18%	20%	53%
Most teachers at this school do not want to take the time to learn how to use computers.....	11%	26%	30%	33%
The computers are used so much, I often can't get access to one myself.....	8%	19%	32%	41%
Most teachers have adequate access to computers for their own use.....	38%	32%	21%	8%

NEEDED RESEARCH AND GENERAL CONCLUSION

The results reported here are the summary of the perceptions of 160 principals, primary computer-using teacher and classroom-using teachers of elementary schools in the State of Oregon.
These results can be viewed as a reliable indicators of how the various aspects of microcomputers usage are seen by the typical elementary school practitioners in Oregon.
All these perspectives held by these school-based educators should be viewed as vitally important information to district administrators. This information indicates that time has come for school systems to support well-designed studies of not only the educationally but cost effectiveness of computer usage in elementary school education. Up to the date of the completion of this survey, more than $ 1,642,872 had been spent on books and other instructional materials by the participating schools. Although more than two hundred thirty thousands dollars (i.e. $234,966, with a mean of $ 1894.00/school) was spent on computer hardware,

only one hundred and twelve thousand dollars (i.e.$ 112,698, with a mean of $ 853.00/school) was spent on software. To conclude then and in light of the results presented here, it might be said that if educators really want to find out how significant the role of computers could become in the education of our youngsters and whether or not budgetary considerations should be reviewed, then in Oregon because so many schools now have several years experience in using computers, the time has come for elementary schools administrators to decide on the future and the place of computer technology in the education of their students.

APPLEWORKS: SPECIAL EDUCATION STUDENT SCHEDULING AND IEP MANAGEMENT

CHRISTIAN LARSEN

INTRODUCTION

For several years I have dreaded the approach of spring. One might think that this is abit peculiar considering that spring is usually viewed as a time of rebirth and new hopes. I am a special educator and for me the spring means the annual grind of testing special education students and the development of new Individualized Education Programs for the ninety students in the various programs at our high school. Before I say more about the development of IEPs, though, I need to state that I firmly believe it is a necessary and worthwhile process we go through each spring. I have just thought that there must be some way to make it more efficient and effective.

Enter the computer! I have dabbled for several years with computers. I have taken a couple of computer programming and application courses. Also I have read everything that I could get my hands. I can write some very simple programs in BASIC and given enough hours in the day I can figure out how some of the programs in the computer magazines work. But I am not a hard-core hacker or programmer. I enjoy the problem-solving aspects of working with commercial programs. I also enjoy seeing what I can accomplish with those software applications.

Therefore the focus of this paper will be on the software AppleWorks and how I have used it to streamline the IEP process and the scheduling of special ed. students. I will speak to how I use the word processor, data base and the spreadsheet to facilitate this process. Also I will speak to how these three areas help facilitate the management of student data. With regard to the hardware requirements, I use an Apple IIc with 128 K with two disk drives and a ProWriter printer at school. At home, I use an Apple IIe with 128 K with duo-disk drives and an ImageWriter II printer.

Lastly, I would like to point out that I have not changed or reprogrammed the AppleWorks software. What I have done with AppleWorks anyone

can do (with alittle help maybe). This is not a new program, but rather a new process using AppleWorks. AppleWorks makes it easier to generate IEPs, manage probe data, and schedule students.

IEP ORGANIZATION

When I think about the time and effort that must go into each IEP so that it is a relevant meaningful document, I know the basis for this is organization. If one looks at the IEP it is generally composed of the form, the demographic information, the assessment data, the goals and objectives and the probe data. Each of these areas has a natural place within AppleWorks.

The Word Processor

Initially, I have used the word processor to generate the templates for the IEPs in our district. This is a time consuming task that should only need to be done once with only minor changes needed as the district updates its own forms. Generally speaking, most of the IEP programs that I have previewed have their forms running down the page rather than across. If your form goes across the page, your first consideration is to place the text on the page so that there is still enough space to insert or type the information for each student. Also one needs to consider whether the information is to be hand written, typed or inserted by the computer. In some cases, lines may be included and in other cases a blank may be left instead. An important consideration when deciding about the use of blanks is that whenever you transfer information from either the data base or the spreadsheet to the word processor, AppleWorks transfers information line by line. If the blank on your form preceeds or follows text, this text will be either pushed up or down depending on the amount of space needed by the inserted information. For this reason, I usually use the overstrike cursor to type in demographic data and leave a complete blank line to insert goals and objectives from the data base. With regard to margins, the top and bottom margins should be set to 0.5 inches, likewise the left and right margins should be set at 0.5 inches. This allows for

maximum utilization of the page. In some cases it may be advantagous to use the proportional-1 text for such items as the due process and parent rights paragraphs that may be included on the back of a form.

Finally, each of these templates should be a separate file with its own unique name such as IEP P.1, IEP P.2, IEP P.3. It is easier to work with the individual files and then merge the files when the IEP is finished. These forms should go down the page (not across). The text on the pages should be placed according to these two considerations: 1) will the information be typed or hand written or 2) will the information be transferred from the data base or spreadsheet to the document in the word processor? If the information is to be typed use the over-strike cursor. If the information is to be transferred to the document form, then leave a complete blank line for the information.

The Data Base

I think the data base is by far the most useful part of AppleWorks aside from the integration aspect of the program. Basically, I have used the data base to maintain a list of IEP goals and objectives that I could retrieve and transfer to the word processor. There are several considerations when developing the data base for either the goals or objectives. Any goal or objective statement has several components to it. Firstly, there is the part that describes the content of the objective-- what the objective is about. The next part describes the conditions of the objective and finally the last part describes the criteria of the objective. There are several ways to write an objective or goal if these components are considered. The first step is to decide how many lines you want each statement to have. For example, you could allocate 3 or 4 lines to each goal or objective statement. Then it would just be a matter of keeping the parts outlined above within those parameters. Another approach to developing goals and objectives would be to assign a line to each of the parts outlined above. In this way it would be possible to customize the parts of the objectives more easily. Another consideration for goals and objectives is the manner inwhich you will identify or make them unique within the data base. There

are of course several alpha and numbering systems that can be used. Which ever system you choose, I think that it must allow for maximum flexibility. You should be able to sellect any one single objective or groups of objectives for the system to work smoothly. I have found that using a decimal numbering system combined with letters gives the objectives and goals in my data base enough uniqueness and flexibility. For example, my data base might start with the following numbers: 1.1A, 1.1B, 1.2, 1.3A, 1.3B, 1.3C, 1.4. In each case, the numbers represent a unique objective number. The goals are easier because there are less of them and they tend to be more general. For example, they might be numbered 1.A, 1.B, 2.A, 3.A etc.

As stated earlier, a goal or objective will take up one full line of text no matter what its length. This line is necessary when you are transferring the goals and objectives to the word processor. Otherwise the text is moved or split on the word processor template. Another consideration when developing the goals and objectives is that the amount of space that they take up on the data base should be the same for the word processor. In other words, if your objectives take up 70 spaces in the data base, then the margins in the word processor should be set so that they can accomodate the same number of spaces. If there are too few spaces in the word processor, the objective is truncated. One can avoid this problem by matching the spaces in the options menu of the data base with the margins of the word processor in its options menu. For example, if the platen width in the word processor is 8.0 inches then the line width in the data base can be no more than 8.0 inches. Usually I try to make the line width in the data base slightly smaller than the word processor. For example, if the platen width in the word processor is 8.0 inches then I would make the data base line width 7.5 inches wide.

The transferring of goals and objectives from the data base to the word processor can be handled in several ways. The main path for this transfer always goes through the clipboard and then to the word processor. For goals, you can elect to choose one at a time or several. Once they are on the word processor template, they can be moved to their appropriate spot on the document. I find it easier to move each goal as I come to it in the IEP. With regard to objectives, I think it is

easier to move all the objectives for a particular goal area rather than picking and choosing among the various objectives. It is far easier to delete the objectives not needed. I have found that if it is the first IEP for a student, then it is easier to create an IEP with all the objectives and then edit it at the IEP conference according to the agreed upon goals and objectives for that school year. If the IEP is already on the computer, then it becomes a simple task of adding or deleting goals and objectives that have either been met or need to be added to it.

The Spreadsheet

I find that the spreadsheet can be used for many useful purposes. I have used it to keep track of grades, attendance, IEP probe data and objectives. With regard to grades, it is easy to set up a spreadsheet in the following manner. Firstly, I start by creating a file for the class I am teaching. After the file has been created I enlarge the column widths so that they can accommodate the assignment names and the student names. I set up the assignments and activities so that they are going down the left side of the sheet. Each group of assignments is separated by a space and the assignments are made into titles using the open-apple T command. This allows them to remain on the screen as you scroll through the data. At the top of the sheet I place the student names for the class. Each student name is followed by one or two spaces so that it is easy to read. Next I make a window across the top that separates the names from the assignments. This is done by using the open-apple W command. In addition, I synchronize the windows so that the names scroll with the data or scores. This allows me to view any student's data in relationship to a particular assignment. A similiar approach is used with student attendance. Student names are placed along the left side of the sheet with two catagories under each one: tardies and absences. Both the student names and the categories are made into titles using the open-apple T command. Along the top of the sheet are placed weekly dates. These dates are separated from the rest of the sheet by a window which is also synchronized with the data below it. This is done with the open-apple W command with the windows synchronized with the same command. At this point, I will not go into the development of individual formulas for

either of the above spreadsheets as this would be depend on how the data is collected or used.

With regard to the IEP probe data, in the past I have used the spreadsheet for keeping track of most of the probes. But I have found it somewhat time consuming because most of the data did not require any form of calculation which is what the spreadsheet is intended for. Therefore my discussion of probe data will be confined to those objectives that require rate or accuracy data. Usually, with either of these types of data I need to keep an ongoing progress report on the student's performance. This is usually in the form of weekly averages or rates. The first step is to pull the student's IEP onto the desk top. Then I select the objectives that I need to keep rate or accuracy data on. After I have noted the objectives, I then create a spreadsheet file for that student that will contain those objectives. At this point, there are several ways to proceed with transferring the objectives to the spreadsheet. In some cases, if there is only two or three objectives to monitor its easier to type them onto the spreadsheet. If there are several objectives, then it may be easier to go to the objectives data base, select the objectives and create a DIF file. When you develop the student's spreadsheet, use the DIF file to get the objectives. This way all the objectives are transferred at once. Then it becomes a matter of organizing the objectives so that both the objectives and the data can be easily read on the screen. Usually, I try to place the objectives so that they are going down the left side of the sheet. It will be necessary to widen the column that contains the objectives. At the top left hand corner I place appropriate headings to identify the various parts. At this point, I make all the objectives and headings titles using the open-apple T command. That way they remain on the screen at all times. The next step is to create a window between the headings and the objectives. The windows should be synchronized so that the identifying information on top follows the data on the bottom window. I have found this format allows you to veiw the objectives and the data at any point in the program. With the probe data from the spreadsheet it becomes a simple matter to update the student's progress on the IEP.

STUDENT SCHEDULING AND MANAGEMENT

Student scheduling, like the management of student IEPs is a process. It starts with the development of the goals and objectives based on the student's present performance levels. This can occurr in several ways. Initially, I started with an IEP worksheet where I could rough out the goals and objectives with the parents. After developing the data bases with the goals and objectives of our school program, it became a simple matter of choosing and editing the appropriate goals and objectives for the student. The parents are given a list of the goals and objectives along with some possible courses. In effect, the list of goals and objectives becomes a catalogue or menu from which to choose. After the goals and objectives are agreed upon, then the courses are chosen that would meet the needs of the student.

At this point, I take the information gathered from the meeting and generate a new IEP and student schedule. To make a new IEP, I need the following files on my desktop Index: the IEP templates and the data bases for the goals and objectives. First I fill out the demographic information and current levels of performance. Then I transfer and edit the goals for the front page. At this point, I add the objective pages to the front page. After transferring and editing the appropriate goals and objectives, I enter the program description and classes on the back page. This back page is also added to the file containing the front and middle pages of the IEP. This whole file is saved under the student's name or any other identifying name.

With students that already have an IEP on the computer, I call their file up on to the desktop Index along with the data bases. Then with the notes from the IEP meeting, I can go through and update and edit the old IEP. The new IEP is then sent home for final approval and signature.

Students are scheduled through the high school's IBM AT computer. In order to facilitate this registration and scheduling process, I generate a list of students and/or classes that the registrar can use to create our special education classes at the high school. I use

several different types of lists to facilitate this process. All these lists are created with the AppleWorks data base.

The first one is a list of demographic data which includes the student name, his/her student ID number, age, birthdate, telephone number, parents/guardians name, and home address. This list is useful in a number of ways. Firstly, there are many times where the information in the school's computer is not very current. Updating the registrar with a new list once a year keeps the school's information current. This list is also particularly useful to the special ed. teachers for parent contacts and scheduling IEPs.

The next list also comes from the data base and deals with the IEP management in the school. The information contained on this list includes the student's name, student ID number, the program manager, the current IEP conference date and when the next one is due. I use this list to keep track of all the IEPs in our building. It allows me to moniter the status of all our IEPs and to schedule conferences with the different teachers about their IEPs.

Another data base list which is used by the teachers concerns the scheduling of IEPs. On this list there is the student name, student ID number, student address and telephone number, the date of the current IEP and a space for the new IEP date.

With regard to assessment data, I use an annual assessment collection form which is also generated from a data base. This list includes all the assessment information for all the students and each teacher is given a copy of this form when the testing process is completed and compiled. Information on this list includes the following: the student name, student ID number, scores in the following areas-- reading, writing, spelling, math and other. The other category may be used for any teating in addition to the normal test battery.

Generally, most of these data base lists are used during the period when the students are being tested, new IEPs are being generated and student schedules are being decided upon. Every two months during the school year, though, probe data must be collected on all the student IEPs. There are several ways inwhich this can be done. A probe collection list can be generated which

includes the subject area, the goals and objectives, and student names. These lists can go around to the individual teachers who then complete and return the forms to me. This data can then be transferred to the student's IEPs and used to develop student acheivement graphs etc.

In summary, the main reason for using AppleWorks to develop IEPs and manage student data and performance is to cut down on the amount of time spend in generating the paper work and to become more efficient. I have always felt that I spent more time writing the IEPs than in actually using the information on them. With the use of AppleWorks, I am able to make the process more relevant, less time-consuming, and easier to manage. In addition, I am able to use the data collected to generate more accurate programs for students.

NETWORKING TEACHERS

Tom Layton

Less than 50% of the 120 microcomputers at South Eugene High School are used for student instruction. We decided, early on, that the lion's share of computing power should be placed in the hands of the faculty and staff. By September of 1987, every counselor's office, every department's office, and nearly every administrator's office will have at least one Apple brand computer. Our goal is to have an Apple Macintosh computer on the desk of every faculty member by 1990. Connecting those teacher workstations with each other and with the district's VAX minicomputer system will provide teachers with unprecedented computing power.

Teachers First

In the fall of 1985 an informal survey of South students indicated that about 45% had a computer in the home capable of word processing. Any attempt to provide a ratio of computers in school similar to that in the home was obviously impossible. South would have to purchase over 800 individual units and corresponding peripherals at a cost exceeding $1,000,000. Costs for training teachers to use the machines to implement the curricula would be astronomical. Although steady progress is being made in that direction, it will be many years before any major educational impact will be seen for the majority of South students using computers.

If we cannot upgrade the educational process by equipping students with computers, substantial gains can be made by equipping teachers with computers. Fortunately, many South teachers have already embraced the power of computers to help them in their daily work. In the same fall 1985 survey, we learned that more than 50% of the faculty owned their own microcomputer at home.

Rising Need

Although South teachers have been using computers for their own work for the last several years, it has only been in the last year that signs of a desire to share computer data has begun to arise. Teachers

who were used to imputing attendance and grades through Scan-Tron sheets are wanting more than end-of-term reports generated by the attendance office. Since Bill was absent from a certain teacher's third period English class today, that teacher wants to know if Bill's girlfriend Sally was absent from her third period class as well. Another teacher wants to know if Tom is really absent the first Monday of every month, or if it just seems that way. Teachers who are trying to advise Sue on her next math course want to have access to Sue's teacher, her grade and her competency completions from her last math class without having to walk the 1/4 mile front hall to find out. Counselors want to know if Ms Murry's 4th period Word Processing class is full without leaving their office. The Spanish I teachers would like to share verb quizzes without fumbling through boxes of floppy disks. The front office secretary would like to put together articles for the South High News without running from teacher to teacher, administrator to administrator, and without retyping half of what she receives. The committee for the "At Risk" students would like to repeatedly update and share information on curriculum without reprinting 20 copies every few weeks. Almost everyone is tired of seeing the trash can next to the teacher's mailboxes pile high with hastily read memos and announcements.

Networking

In order to share files and access data, teacher workstations at South must be physically connected to each other and to the district VAX minicomputer. In the fall of 1987, the VAX will be running a district-wide attendance, scheduling, and student record keeping system. In order for teacher computers to access this information they will have to emulate the dumb terminals (VT100 or VT220 emulation) normally attached to the VAX over EtherNET. In order for teachers to access each other, they will be connected in an AppleTalk Local Area Network with the AppleShare software acting as a file server running on a dedicated Macintosh, and using PhoneNET connectors. Connecting the VAX and EtherNET with the AppleTalk LAN consisting of Macintosh workstations will probably be accomplished with a Kenitics FastPath bridge. This connection may prove even more useful with AlisaTalk, a file server for AppleTalk running on the VAX.

If the above paragraph sounds as if it were written in a foreign language, do not despair. That was my first impression of networking as well. Perhaps it might be appropriate at this time to explain a few terms.

VAX - is a very powerful minicomputer produced by Digital Equipment Corporation. Like its mainframe relatives, it is usually accessed though terminals. The terminals have almost no computing power of their own. Everything runs on the central machine.

EtherNET - is an extremely fast Local Area Network medium for the VAX and other very powerful minis and workstations. Terminals could be plugged directly into the VAX, but plugging them into EtherNET offers several advantages, the most important of which is flexibility.

AppleTalk - is the Local Area Network designed by Apple computer for Apple machines. Macintoshes and the new Apple GS have AppleTalk hardware built into the machine. It is not necessary to purchase additional boards to connect them to the **LAN** the way one would have to with, say, an IBM AT PC. Installation is easy with AppleTalk connectors and cables.

PhoneNET - is the name of the AppleTalk connectors and cables we selected for physically connecting our Apples together in an AppleTalk network. Of course, Apple makes its own connectors, but the relatively inexpensive PhoneNET connectors allow you to use the existing phone lines in a building as the heart of the AppleTalk cabeling system.

Macintosh - is presently the computer of choice for an AppleTalk network. There is rumor that the Apple IIGS and perhaps even the Apple IIe will eventually be usable in an AppleTalk network. (The built-in AppleTalk capability of the GS is evidence of those plans.) Currently, however, the Macintosh has all of the hardware and software to make a successful, easily assembled **LAN**.

FastPath - is a device for connecting two basically dissimilar Local Area Networks -- EtherNET and AppleTalk. It is a "black box" that will provide every Macintosh user on the AppleTalk system with access to programs running on the VAX. That means that teachers can have access to grades, scheduling, attendance and student demographics using the Macintosh on their desk. Of course, they will have to use Macintosh software that temporarily turns their Macintosh into a dumb terminal resembling those normally used on the VAX.

AppleShare - is a file server for the AppleTalk Local Area Network. This file server consists of special software running on a dedicated Macintosh and a number of hard disk drives. AppleShare allows teachers and administrators to store their files and programs at a central location. It appears to users that they have their own hard disk attached to their computer. The difference, of course is that everyone is

sharing the same hard disks. Since everyone is attached, it is easy to share files between different users. AppleShare does this by assigning people to different groups. A teacher may belong to the group "Staff", the group "English Department", the group "Student Affairs Committee", and a group consisting of only that particular teacher. Only teachers who belong to the group "English Department" have access to those particular files.

AlisaTalk - is similar to AppleShare in that it is an AppleTalk file server. However, it currently is less sophisticated than AppleShare and it exists on the VAX instead of on a dedicated Macintosh computer. Because it runs on the VAX it may be faster than AppleShare, it may be easier to back up, and it may allow for more storage capability.

Other Stuff

Once an AppleTalk LAN is established using AppleShare, additional software and hardware can be added to the system. The following are some of the additions under our consideration:

InterMail -- is a highly sophisticated electronic mail system for an AppleTalk network. It will allow users to maintain electronic mail boxes on the central hard disk. Not only can teachers can send and receive text messages and memos to each other, they will be able to transmit graphics, spreadsheets, PageMaker documents, and any other type of file that can be produced on a Macintosh. Sophisticated features such as mailing lists, return receipt requested, and priority mail are included in the system.

R-Server -- is another "black box" that will allow teachers at home with a Macintosh and a modem to tie into the AppleTalk LAN at school. They can retrieve graphics, type a test, print it on the school's LaserWriter, and pick it up in the morning on their way to the copy machine.

ModemShare - is software for the AppleTalk network that allows all users on the LAN to have access to a single modem. One of the major advantages of a LAN is to allow the sharing of seldom used and expensive equipment. This is a good example.

SouthLAN

In August of 1987 South Eugene High School will implement a pilot building-wide Local Area Network called SouthLAN. SouthLAN is basically the same structure as the foreign language sounding paragraph above. South will receive, on consignment from Digital Equipment, a microVAX minicomputer. That computer will be linked to the larger VAX at the district office. It will have dumb terminals attached to it locally over the EtherNET cabling system. Those terminals will basically be used by clerical personnel such as the attendance clerk.

South's microVAX will also be attached to an AppleTalk LAN consisting of Apple Macintoshes. The connection to the AppleTalk LAN will be via a Kenetics FastPath. The Macintoshes are placed in teacher, counselor and administrator offices. The software that will allow staff members to share files will be either AppleShare (running on a dedicated Macintosh); AlisaTalk (running on the VAX); or both systems at the same time. Staff members will also be able to access the same programs running on the VAX that can be accessed with the dumb terminals. To accomplish that, the Macintoshes will use terminal emulation software to make the VAX think it is talking to a dumb terminal. Real dumb terminals will not have any access to the AppleTalk network or any of the files on AppleShare or AlisaTalk. Staff members will be able to access the AppleTalk LAN from home via the R-Server and work in the same way they would at school, although much slower. We will also have electronic mail, both on the VAX and over the AppleTalk network using InterMail.

What all of this means is that faculty and staff will have an extremely powerful method of communicating information and will allow them to concentrate on the business at hand -- educating kids.

Networking Products

AlisaTalk™
$3750
Alisa Systems
220 E. Walnut Ave., Suite 230
Pasadena, CA 91101
(818) 792-9474

AppleShare™
$800
Apple Inc.
Cupertino, CA

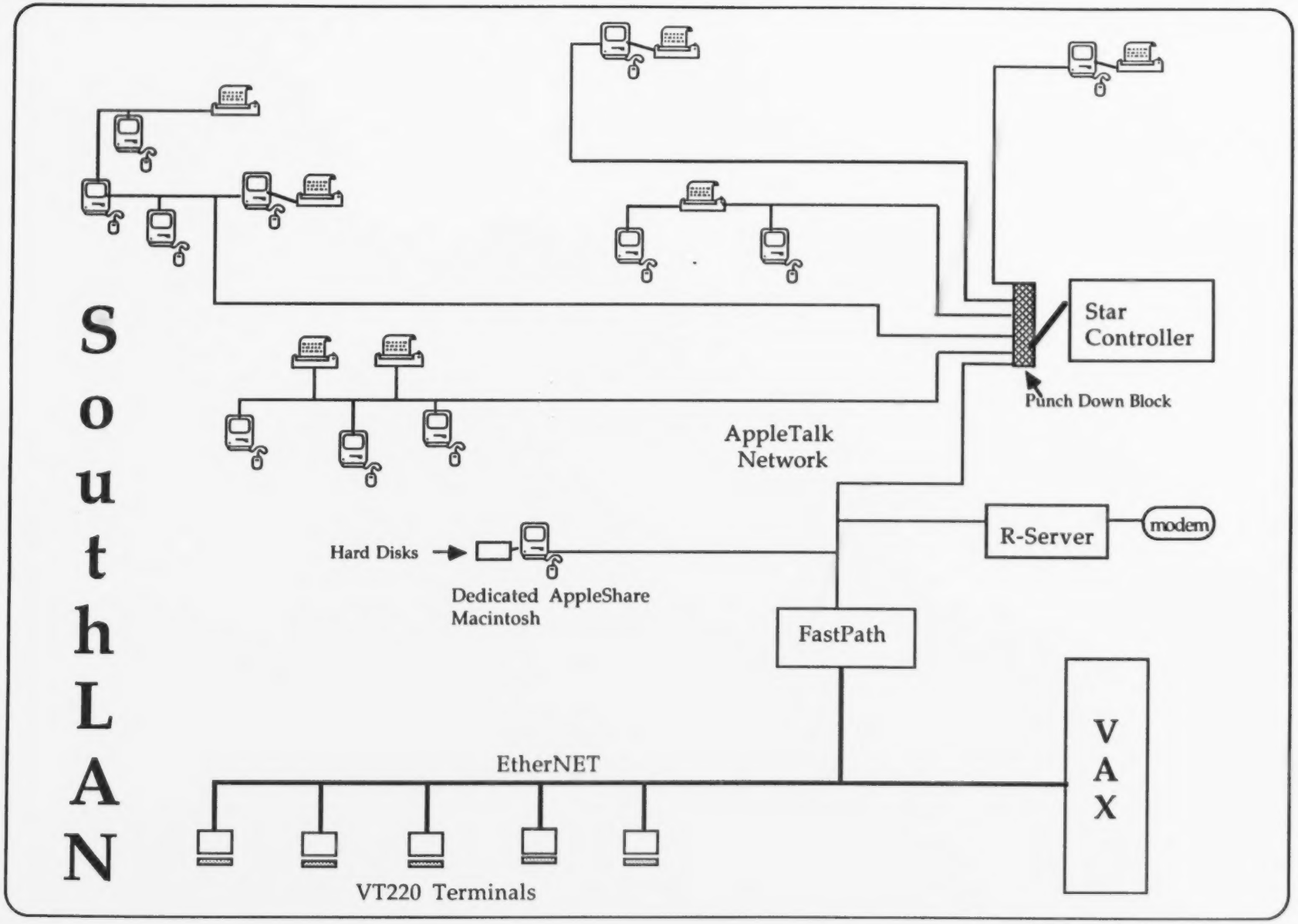
FastPath™
$2500
Kinetics
PO Box 3341
Walnut Creek, CA 94598
(415) 947-0998

InterMail™ System
$949 (21+ users)
Interactive Network Technologies Inc.
20 Amy Circle
Waban, MA 02168
(617) 965-5239

ModemShare™
$200 per server
Mirror Technologies, Inc.
2209 Phelps Road
Box 304
Hugo, MN 55038
(612)426-3276

PhoneNET Plus™ Connectors
$49.00 each
PhoneNET StarController™
(with Management option)
$1495
Farallon Computing
1442A Walnut Street, Suite #64
Berleley, CA 94709
(415) 849-2331

R-Server™
$495
Solana electronics
7887 Dunbrook Road
Suite A
San Diego, CA 92126
(619) 566-1701


SouthLAN
Star Controller
Punch Down Block
AppleTalk Network
R-Server
modem
Hard Disks
Dedicated AppleShare Macintosh
FastPath
VAX
EtherNET
VT220 Terminals

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SHOULD STUDENTS USE SPELLING CHECKERS?

Janice Adele Meyer, Ph. D.
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" Yes!!"--say high school students who are now suffering from withdrawal symptoms because their spelling checker software was taken away at the conclusion of my research.

" Yes!"--say the participating high school teachers who saw some gains, which they considered to be impressive, in the writing skills and spelling achievement of their students who used spelling checker software.

" Maybe"--say some educators who are waiting for volumes of research to determine either the positive or negative aspects of spelling checker software usage.

" No!!"--say some teachers. "They're a crutch just like calculators in math."

What Does Research Say Regarding The Use Of Spelling Checkers With Word Processing Programs?

Not much. A search of the literature revealed no empirical studies specifically regarding the effects of spelling checkers, used in conjunction with word processing, on the spelling achievement of students even though word processing programs and their enhancements, including orthographic aids, are rapidly growing in popularity.

Why Is Research Regarding Electronic Spelling Checkers Important?

Word processing programs are now being used more in the language arts curriculum because of the advantages they appear to offer writers (Bradley, 1982; Daiute, 1985; Green, 1984; Schwartz, 1982). Why has word processing become so important in the area of writing skills? Writing is done in the schools for the purpose of helping students "discover what it is

they learn. In the act of trying to put down words, students can discover their ideas, sharpen their thoughts, and order their thinking" (Marcus, 1984, p. 54). This process has often been considered "drudge work" because of the many corrections, sometimes numerous and messy, and refinements necessary to perfect writing. Now writers can use computers to do the drudge work. Student writers can turn over to the computer the task of storing information, assisting in the correction of misspellings, recopying, and reformatting the text. While the computer is doing all these tasks the writer is freed to think (Daiute, 1983; Schwartz, 1982).

Secondly, spelling should be an integral part of writing. It should be taught in a meaningful context--the writer's expressed thoughts (Allred, 1984; Manning, 1981)--not as some subject in isolation. Some educators question why so much emphasis is put on correct spelling when writing experts are telling them students who are in the prewriting and writing stage should not be hampered in their creative thinking by mechanical concerns such as spelling. Writing experts and spelling authorities both stress correct spelling, especially in the post writing aspect of the composition process. Peters (1985) believes correct spelling should be emphasized because: (1) poor and careless spelling causes communication to suffer because a lack of precision brings about misinformation or misunderstanding of the message intended; (2) good spelling continues to be considered a sign of literacy; (3) some children and adults are freed to write only when they have learned to spell correctly; and (4) the writing of poor spellers may be simpler in vocabulary and less precise in meaning because they are not confident in the use of new words found in their vocabulary. Allred concludes that "Accurate spelling is important at all levels of written composition because it greatly influences a writer's creativity and effectiveness" (1984, p. 8).

Thirdly, computers have become an important teaching tool in spelling instruction (Allred, 1984; Balajthy, 1986; Garsh, 1984). Computers have been and are being used to teach spelling. They are used for drill-and-practice and tutorial computer-assisted instruction as well as to individualize students' spelling programs. Computer software can provide for a variety of student learning styles. For the visual learner, the visualization of spelling words on the computer monitor is extremely important, especially considering the fact that most spelling authorities

believe spelling is mainly a visual task (Allred, 1977; Fitzgerald and Loomer, 1984). Recently, spelling software has been enhanced with speech synthesis which may benefit auditory learners.

What Are Electronic Spelling Checkers And How Might They Assist Students With Their Writing Skills and Spelling Instruction?

In order to understand how spelling checkers may benefit students in the area of writing skills and spelling instruction it is necessary to understand the concepts upon which spelling checker software is based. In general, spelling checkers are microcomputer software containing built-in dictionaries of correctly spelled words. The text created by the writer on a word processor is analyzed by the spelling checker and compared with words in the internal dictionary to find a matching word. If this match is not found, the text word is reported as a possible misspelling. When a word is reported as being possibly misspelled, various possibilities for the correct spelling are typically presented to the writer. If desired, new words may be added to the internal dictionary, thereby individualizing or customizing the dictionary in such a manner as to serve as the writer's own personal vocabulary directory. In this way, names and technical terms can be added to augment the basic dictionary.

There are basically two types of spelling checkers used in an educational setting: resident (integrated) spelling checkers and nonresident (stand-alone) spelling checkers (Eiser, 1986; Janus, 1986). Resident programs reside in the omputer's memory along with the word processing program. With such a resident program the user can "toggle" back and forth between the main program (the word processor) and the resident program (the speller checker) by using two predefined keystrokes. There are four modes of checking which may be offered by a resident spelling checker: interactive, single, full screen, or full document. Any or all of these four may be used when the spelling checker is active. After all checking is done by the resident spelling checker program, the users then return to the word processor in order to print out a corrected copy of their work.

Nonresident (stand-alone) programs are used during the revision or editing stage of the writing process after writers have completed their writing and saved the file to disks. In order to use this type of spelling checker it is necessary to quit the word processor and load the spelling checker into the computer's memory. The words in the document are then "read" alphabetically and checked against each word in the spelling checker's dictionary. Those that do not match are counted and displayed on the screen as questionable words to inform the user that the word is possibly misspelled. The next step with this type of spelling checker is for the program to highlight each questionable word and to ask the writer what should be done about the particular word. It then presents possible options, such as "Ignore the highlighted word", "Add to the auxiliary dictionary", or "Suggest an alternative". The original word processor must be rebooted and the correct file called up if the writer wishes to print the correct version.

Although microcomputer spelling checkers were originally developed solely as a tool to check spelling, my research indicates that they may also be a beneficial tool for spelling instruction. Some microcomputer spelling checkers can provide a multisensory approach to learning which is necessary in spelling instruction if all students are to be taught according to the teaching style by which they learn best. If spelling is primarily a visual exercise, as is often asserted, then students whose visual sense is weak can learn to spell if visual training is provided by the spelling checker. Also, the use of microcomputer spelling checkers combines the kinesthetic-tactile learning modality with a visual approach when the computer keyboard is used to input data. Finally, if speech synthesis is added to the spelling checker program, the auditory modality enters into the learning process and offers training in auditory perception and auditory discrimination which supplements the visual and kinesthetic-tactile aspects of learning.

What Does My Research Say Regarding the Possible Benefits Of Electronic Spelling Checkers?

Research Questions

My research to date has explored the effects of electronic spelling checkers on the spelling achievement of a group of randomly selected high school students. The study sought to determine if students who used an electronic spelling checker, in conjunction with a word processing program, showed: (l) greater gains in spelling achievement than students who used word processors without spelling checkers; (2) an increase in expressive vocabulary; (3) an increase in functional spelling skills; and (4) a decrease in specific types or categories of spelling errors. The study also attempted to determine what relationship, if any, exists between keyboarding skills and improvement of spelling achievement when students used spelling checkers.

Spelling Achievement

The greatest gains in spelling achievement were made by the poorer spellers in the experimental group, i.e., the group that used spelling checkers. The poorer spellers, (those scoring below 69% on a standardized spelling achievement test), made an average gain of 6 percentage points. The poorest speller went from 49% on the pretest to 62% on the posttest, a gain of l3 percentage points.

Expressive Vocabulary

A comparison of the initial and final expressive writing samples, shown in the tables below, indicated that the experimental group, with an increase of l45.94 total words and 48.00 unique words, showed a greater mean gain than the control group which exhibited an increase of 63.64 total words and 8.73 unique words. This comparison suggests that the use

of a spelling checker may assist in the expansion of an expressive vocabulary used for writing purposes.

Table I. A Comparison of Experimental-Group and Control-Group Means for the Initial Expressive Writing Essay

Group	N	Initial Expressive Writing Essay	
		Total Words M (SD)	Unique Words M (SD)
Experimental	15	341.73 (64.83)	160.47 (30.53)
Control	11	367.36 (98.60)	191.27 (55.27)

Table 2. A Comparison of Experimental-Group and Control-Group Means for the Final Expressive Writing Essay

Group	N	Final Expressive Writing Essay Total Words M (SD)	Final Expressive Writing Essay Unique Words M (SD)
Experimental	15	486.67 (157.40)	208.47 (60.70)
Control	11	431.00 (l63.63)	l99.00 (55.27)

Functional Spelling Skills

Raw scores and percentages indicated that, on posttests, the experimental group made fewer misspellings than the control group even though they wrote more total and unique words. The control group, by contrast, made more misspellings although they wrote fewer total and fewer unique words. This was a reversal of the pretest scores.

Specific Types of Spelling Errors

Substitutions, omissions, additions and transpositions were analyzed in the research. The results indicated that certain types of errors, such as substitutions and omissions, seem to decrease when a spelling checker is used.

Typing Speed and Spelling Achievement

A comparison of spelling achievement for slow and fast typists in both groups indicated that for both groups combined, the experimental and control groups, fast typists made higher mean scores for both the pretests and posttests.

Conclusions Based On My Research

One of the most important conclusions of this exploratory research is that the use of a spelling checker program neither definitely assists nor hinders spelling achievement on a standardized spelling test. There are other implications from this research which are educationally significant even though data analyses did not find them to be statistically significant. This includes the suggestion that a spelling checker program assists in increasing written expressive vocabulary. There is the possibility, also, that an increase in functional spelling skills may occur with the use of a spelling checker, particularly with certain categories of spelling errors. In addition, a specific relationship may exist between typing abilities and spelling achievement thus enabling fast typists to show greater gains in spelling achievement than slow typists.

Should Students Use Spelling Checkers?

The study shows that a spelling checker certainly has no negative effect on student performance on any of the various categories analyzed; if anything, it may have a positive effect on increasing the expressiveness of students' written vocabulary by encouraging them to write more freely and by diminishing certain categories of spelling errors. Secondary school teachers should feel no hesitation in permitting or even encouraging their students to use spelling checkers in conjunction with word processing software on microcomputers.

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THE APPLE CLASSROOM OF TOMORROW

Dr. Samuel K. Miller

Project Background

The Apple Classroom of Tomorrow (ACOT) is a research and development project sponsored by Apple Computer, Inc. Conceived and directed by Dr. Martin Engel of Apple's Advanced Development Group, the project's goal is to create instructional environments in which every student has complete access to a classroom and home computer in order to learn how to maximize computer use for the entire school curriculum.

To accomplish these changes, Apple has provided hardware, software, and personnel support during the 1985-86 and 1986-87 school years to a select group of seven elementary, middle, and senior high school classrooms in school districts throughout the United States. The Apple Classrooms of Tomorrow are set in school districts of computer-using leaders in public education, but each site is different with regard to grade level, socio-economic factors, and instructional focus. Although the school districts participating in the project have signed an agreement with Apple, each project site has autonomy in organizing curriculum and instruction and in staff selection.

Dr. David Dwyer, the project's Senior Education Research Manager, joined Apple's staff in September 1986 and developed a research agenda for the project. All participants in the ACOT project share responsibility for documenting the progress of the project at each site. At present the primary data-gathering methods for the project are interview and observation.

Eugene Project Overview 1985-87

Students and Staff

The Eugene School District has 44 schools that serve over 17,000 students. Eugene's Apple Classroom of Tomorrow project was at Colin Kelly Middle School. Colin Kelly provides instruction for 420 students in

grades six through eight. The school population is primarily white and consists of a large number of students from low socio-economic families.

Eugene's Apple Classroom of Tomorrow consisted of 45 sixth- and seventh-grade students randomly selected from the population of students enrolled at Colin Kelly Middle School. The sixth-grade class had 13 boys and 13 girls; the seventh-grade class had 12 girls and 8 boys. The seventh-grade ACOT students entered the program as sixth graders and completed two years in the project. Throughout the project, parents had the option to place their child in the regular middle school program.

Michael Caley and I shared instructional responsibility in the Apple Classroom during the 1985-86 school year; however, we did not teach the class at the same time. Both of us are experienced elementary and middle school teachers with extensive backgrounds in curriculum development and computer education. Patsy Sparks, an experienced teacher at Colin Kelly Middle School, became the third project staff member during the 1986-87 school year. Patsy, with a limited background in using computers in the classroom, gradually acquired many skills in using technology-based instruction through assistance from her fellow staff members, experience, and hard work.

Resources

During the 1985-86 school year, Eugene's Apple Classroom of Tomorrow provided each of 26 sixth-grade students at Colin Kelly Middle School with an Apple IIe system for use during the school day and an Apple IIc microcomputer for use at home. Apple Computer, Inc., also provided an additional classroom and home set of computers for a seventh-grade Apple Classroom of Tomorrow during the 1986-87 school year.

Eugene's project goals extended beyond using computer technology for instruction to include the integration of videotapes, videodiscs, and calculators in addition to traditional curriculum materials. Eugene's project was also the recipient of a $35,000 networking hardware and software award from Corvus Systems, Inc.

Major software contributors to the project included Scott, Foresman and Company, Mindscape, Scholastic, Sunburst, DLM Teaching Resources, Holt, Rinehart and Winston, Sensible Software, and Broderbund Software. Eugene's project staff and students were fortunate to have access to more than $200,000 worth of computer hardware, software, and peripherals.

Curriculum and Instruction

Students at Colin Kelly Middle School received instruction during a seven-period school day. Sixth-grade students were in the Apple Classroom of Tomorrow for a five-period block, and the seventh graders were in ACOT classes for four periods. The main subjects taught to both classes were mathematics, science, language arts, social studies, and reading. Students in both classes were in cross-graded performance groups for reading, language arts, and mathematics. They received physical education and elective instruction during class periods they were not in the Apple Classrooms.

The curriculum resembled conventional sixth- and seventh-grade subject matter with the primary difference being the use of technology to supplement or supplant the traditional instruction. For example, students learned, practiced, and applied the school district's goals and objectives for coordinate graphing by using the *Apple Logo II* programming language. Another example is composition instruction; all of the students' written work was composed and checked using the *AppleWorks* word processor and *Sensible Software*'s spelling checker.

A limited amount of computer-managed instruction was used to reinforce basic language arts and mathematics skills; computers were rarely used in Eugene's project for initial instructional purposes. The primary use of the computer was as a tool for collecting, sorting, and analyzing data, writing, and creating computer graphics.

The students began their first year in the project with daily keyboarding instruction for eight weeks. The average at the end of the 1986-87 school year on a timed touch-typing test for both classes was 26 words per minute with two errors or less. With students' individual keyboarding rates ranging from 10 to 53 words a minute, all of the students were facile at using a word processor for their written work.

As the school year progressed, the amount of class work centering around computers increased. The shift from conventional instructional materials to computer-based instruction can be attributed to an increase in expertise and confidence by the project students and teachers.

A visitor to the classroom would have observed a group of students who were comfortable using computers. The visitor would also notice that the students enjoyed their work but still behaved like "regular" middle school students. Not surprisingly, Eugene's Apple

Classroom of Tomorrow had its share of students who didn't listen to directions or remember to complete their homework.

The Home Connection

Before computers were sent home with students, their parents were required to attend two training sessions. The project staff taught the parents how to assemble and use their home computer. If parents already had or could afford to insure their child's computer, they did; otherwise the computers were uninsured. This posed no problems, and all of the machines were returned intact at the end of the project's second year.

Additional parent-training classes were offered but were cancelled due to lack of interest. Several parents assisted in the classroom or served on the project's advisory committee. All of the parents were enthusiastic about the project and seemed to be pleased with the experience their child received.

Students used their home computers to practice keyboarding and to complete homework assignments using *AppleWorks* or *Apple Logo II*. Selected software was also loaned to students during the year for independent use. If students had problems at home using a program or their computer, they frequently called a project staff member for assistance. Students carried their data disks between school and home in a plastic case and printed their work at school. This procedure worked quite well except for some students who consistently forgot their disks. Some things never change.

Project Evaluation

The Eugene School District's research department assisted the project staff in devising and implementing an evaluation plan. Eventually the research department will issue an evaluation report for the project. The project's preliminary evaluation included a comparison of the 1985-86 Apple Classroom of Tomorrow students with sixth-grade students in the regular Colin Kelly Middle School program. Several measures were obtained, including standardized tests, compositions, attitude surveys, attendance, and behavioral records. Additional data were collected by an ethnographer assigned to observe and document life in the Apple classroom.

A review of the 1985-86 project data indicates that students in the Apple Classroom of Tomorrow performed as well on the standardized tests as their peers who received instruction in the non-computer classroom. The

data from the writing assessment indicate that the Apple classroom students scored higher than the comparison group in writing quantity. Writing quality scores between both groups were not significantly different. In general there appeared to be no significant difference in student attitudes or attendance data. The 1986-87 project data is presently being summarized; however, the preliminary results appear to be comparable to those of the project's first year.

Observations and Recommendations

Until the District and Apple release a formal evaluation report, there are a number of useful observations and recommendations based on the Eugene project staff's experiences during the past year and a half.

Software and Hardware

Instructional software developers must begin to take full advantage of the computer's data-gathering potential. Most instructional software fails to provide a meaningful record about student performance at the computer. True individualized instruction and the successful implementation of computer-saturated classrooms will be impeded until data management standards are established and promoted industry-wide.

Networking systems that are faster, more reliable, easier to use, and supported by a broad base of networkable software are essential for computer-saturated classrooms. The staff and students in Eugene's Apple Classroom of Tomorrow managed hundreds of floppy disks daily. Disk duplication and storage is expensive and time-consuming and fails to use fully the computer's data-gathering strengths.

There are a number of educational products that are suitable for teaching single topics or short units of instruction. What is needed in a technology-based classroom are more instructional products such as the *Voyage of the Mimi* that integrate video, print, and computer materials.

Textbook adoption standards requiring publishers to provide computer-based activities correlated with textbook instruction is helpful for curriculum planning in computer-saturated classrooms. Mathematics textbook publishers must now comply with such a standard. Eugene's Apple Classroom students used Scott, Foresman mathematics and reading texts that incorporated

computer-based activities. These materials were well-received by both staff and students.

Environment

The design of school buildings and computer hardware must be adapted to accommodate computer-saturated classrooms. Some common problems experienced in Eugene's project are outlined below.

- Students in the project frequently complained about glare on their computer screens. Windowless classrooms with dimmer-controlled zoned lighting fixtures and monitors with glare filters must be provided to prevent viewing fatigue.

- Temperatures in a computer-saturated classroom can become quite warm due to heat dissipated by hardware and students. Adequate air filtration systems need to be installed in classrooms with heat-producing hardware.

- The simultaneous use of several dot matrix printers in the Apple classroom created too much noise. Some form of acoustical treatment for the classroom and the hardware is necessary.

- Computer-saturated classrooms are a morass of cables. Adequate cable, electrical, and phone routes need to be incorporated into the design of schools. Using fiber optic cables capable of accommodating both audio and video connections would be helpful.

- The floor space of typical classrooms is too small for a computer-saturated learning environment. The result is limited storage space and open areas caused by computers that must be organized around the periphery due to electrical and furniture requirements. Computer-saturated classrooms must have enough room to accommodate instructional clusters that may require students to work individually, in teams, or as a large group.

Staff

Constant access to computers gradually altered the instructional orientation of the project teachers by helping them expand their instructional repertoire. Three examples are outlined below.

- The teachers believed that constant access to computers in conjunction with the design of some

instructional software prompted them to increase instructional activities that required cooperative learning among students. The teachers' tendency in the past had been to instruct students as a group or to assign independent work.

- Computer-based problem-solving activities that are difficult to manage in print form began to appear more frequently in lesson plans for Apple Classroom students.

- The project staff was more willing to assign written work in all subjects simply because the legibility of word-processed papers made correction work more tolerable.

It is too early to speculate whether or not these changes will result in students who are better writers, problem-solvers, or members of a group. The opinion of the project teachers is that these changes are desirable and would most likely not occur in a conventional teaching environment.

Students and Classroom Instruction

The instructional impact in terms of quantifiable results will be summarized in the Eugene School District's research report. The next section summarizes the subjective impressions of the project teachers with regard to the effects of 24-hour computer access.

- Students who entered the project with good study habits, academic skills, and attitudes toward school demonstrated the most interest in using computers at school and at home. In general, students with low skills in these areas continued to demonstrate academic and behavioral problems and made limited use of their home computer.

- Sixth- and seventh-grade students in the project became facile at keyboarding and learned to use the basic functions of the *AppleWorks* word processor with approximately 26 hours of classroom instruction. The time was distributed over an eight-week period with two daily 20-minute instruction and practice sessions.

- A substantial amount of time was necessary for teaching students keyboarding and program operation skills. However, students continuing from the first year's project required far less time for these skills because they retained what they learned in the first year.

- Most of the students enjoyed using Logo and were comfortable with the language. However, requiring students to program as a prerequisite for learning problem-solving or mathematics is questionable. Some students had difficulty using the language and could not generalize their knowledge to non-Logo contexts.

- Students in the project seemed to work together better than students the staff had taught in past years. This may be attributed to the unique ways computers can pose stimulating problems coupled with increased opportunities for students to practice cooperative problem-solving.

- The teachers did not observe students becoming socially withdrawn or isolated due to increased use of or access to computers. Working in a computer-saturated environment seemed to provide students with more opportunities to interact with their peers, teachers, and family.

- Students in the Apple Classroom of Tomorrow did not exhibit an overwhelming awe or singular love for computers or their applications. The students could not clearly articulate why they liked computer-based instruction, but they did.

Future Directions

The Eugene School District is committed to the continued study and application of technology-based instruction in the schools. Eugene's Apple Classroom of Tomorrow will become part of the daVinci Middle School beginning in September 1987. The primary goal of this alternative school will be to use instructional technology to help students do their best educationally.

The daVinci campus will be established as a school-within-a-school at Colin Kelly Middle School, will enroll students from throughout the District, and will share staff with the host middle school. This model provides an opportunity for students to learn in an environment that uses computers and allied technologies while participating in other aspects of the host school's program.

The school will begin with a program for students in grades six and seven and will add an eighth grade in September 1988. The ratio of students to computers at daVinci will be 1:1 in all language arts classes and 1:2 in mathematics, science, and social studies classes. A class set of computers will be available for students

continuing from the 1986-87 sixth-grade Apple classroom; however, the school will not loan other students home computers.

The daVinci Middle School is a logical extension of the Apple Classroom of Tomorrow project. The district's participation in ACOT provides an equipment and experience base that will allow the successful beginning of daVinci.

RESOURCES FOR COMPUTER EDUCATORS

Anant Kartik Mithal

We are computer educators, and we are in the information age. That is interesting, because the tool around which much of our lives are based, the computer, is one of the causes of the information age. But, whatever the cause, the amount of information available to us is increasing rapidly, and we need to keep abreast of it. We need to know what philosophies underlie our field, and we need to keep pace with its rapidly changing frontiers.

In this age, information is available in many forms: television, radio, compact disk, computerized data banks and microfiche being among the newer forms. Yet a very large amount of information is still made available in more traditional forms: books and journals. This paper is about the books and journals that are of use to computer educators.

There is a great mass of both books and journals to choose from and this has its negative aspects. Computer educators have a hard time deciding what to read, and often do not read anything. It came as a surprise to me that many had not read *Mindstorms* and *Tool, Tutor, Tutee*. This article provides two resource lists as an attempt to alleviate the problem. The list of books contains a selection of the important readings in the field. The journal list provides guidelines to the kinds of journals that computer educators should be reading. It is my hope that after a computer educator has read some of them, he or she will be in a position to make better decisions about what journals and books to read in the future.

Books

Books present theories and ideologies that have developed over time, they contain the refined thoughts of people who have spent many years working with and thinking about computers and education. It might come as a surprise to some that Papert´s work in LOGO began in the early 70´s, nearly a decade before Mindstorms was published.

Books that are of use to computer educators can be put into three broad categories: computers in education, general and ´fun´ books. Computers in education books are those which deal with the educational uses of computers. The second category covers a range of topics that affect computer educators, drawing from areas such as education, psychology and computers. Finally, fun books can be used to liven up a computer course, while still offering useful information about computers.

Books on Computers in Education

Becker, Henry Jay. *Microcomputers in the Classroom: Dreams and Realities*. ICCE 1747 Agate St., Eugene, Oregon 97403.

Short paper that addresses problems and possibilities associated with the use of microcomputers in classrooms. Its focus is on different instructional techniques that use micros and on general social considerations that arise when trying to integrate microcomputer based activities into ongoing classroom environments. $3.50.

Bork, Alfred. *Personal Computers for Education*. New York: Harper & Row, 1985.

A look at what is happening in the field of computers in education. (From cover:) 'Despite all the talk about classroom computers, Bork believes that their importance for education is really little understood, and in fact, computers are being misused.' Book has three sections: how computers should be used in teaching, the advantages and disadvantages of using the computer in education and long-range effects of computers on education.

Daiute, Colette. *Writing and Computers*. Reading, Massachusetts: Addison-Wesley Publishing Co., 1985.

About the use of word processing in composition. Most complete study of the research, discusses pedagogic strategies. Is research based and of use both to the language arts specialist as well as to the computer educator.

Hunter, Beverly. *My Students use Computers: Computer Literacy in the K-8 Curriculum*. Reston VA: Reston Pub Co., 1982.

Concerned with the use of database management programs in classrooms, mainly for science and social studies. The book covers CAI, curricula and planning. The book is aimed at educators at all levels. It addresses the issue of whether computers should be used or not and is based around a series of projects for different grades.

Kleiman, Glenn. *Brave New Schools: How Computers can Change Education*. Reston Virginia: Reston Publishing Co., 1984.

Kleiman describes the program at the fictional Babbage School, thus creating a model for use, with many suggested variations. The book takes a close look at the computer in the classroom and the many ways in which it can be used as a learning tool. It describes what is possible today and what may occur in the future. The book talks about new methods in teaching and the new definitions of learning that are being explored.

Moursund, David. *The Computer Coordinator*. Eugene, OR 97403: ICCE, 1985.

(from preface) "Book analyses computer coordinator responsibilities and suggests needed qualifications. It also examines the nature of many current computer coordinator positions."

Moursund, David: *High Tech/High Touch: A Computers in Education Leadership Development Workshop*. Eugene, Oregon: ICCE, 1986.

Materials for 'Leadership Development Workshops,' divided into 1-3 hour sessions. Topics covered include: active listening, computers in instruction, leadership traits, problem solving, goals of computer education, analysis of the CAL goal, computer integrated instruction and the computer coordinator. Based on Moursund's workshops on computers in education.

Moursund, David: *Computers and Problem Solving: A Workshop for Educators*. Eugene, Oregon: ICCE, 1986.

Moursund believes that problem solving is an important aspect of every academic discipline, and that computers are useful aids in solving a wide variety of problems. Book develops a four part model of problem solving: givens, goals, guidelines and ownership. Discusses ways of approaching problem solving using computers.

Moursund, David; Ricketts, Dick: *Long-Range Planning for Computers in Schools*. Eugene, Oregon: Information Age Education, 1987.

Book is also available on disk (Macintosh). Moursund suggests that education has reached the informatio age, but that education is still in the industrial age, with vestiges of the agricultural age. Suggests that there is not much long range planning in schools, and particularly, little for computers in education. Purpose of the book is to improve education by increasing the amount of long range planning for educational computing.

Papert, Seymour. *Mindstorms: Children, Computers and Powerful Ideas*. New York: Basic Books, 1980.

The book that defines the Logo programming language. One of the classics of computers in education, a must for any computer educator. It is one of the most highly quoted books in the field.

Snyder, Tom; Palman, Jane. *In Search of the Most Amazing Thing: Children, Education & Computers*. Reading, Mass.: Addison-Wesley Pubs, 1986.

Book claims that a lot of money has been spent on computers in schools, and asks what the result has been. Chapters include: Great Expectations/Real Life/In Search of the Most Amazing Thing/The Indefatigable Drill Master/Mind Tools/ Its How You Play The Game. Book says that the computer is both a problem as well as a solution. Suggests what educational priorities are and what they should be.

Taylor, Robert P (Ed.). *The Computer in the School: Tool, Tutor, Tutee*. New York & London: Teacher´s College Pr, 1980.

One of the ´classics´ on computers in education. Contributed to by five pioneers: Alfred Bork, Seymour Papert, Patrick Suppes, Arthur Luehrmann and Thomas Dwyer. Consists of a collection of essays. Has been endorsed as a document of the Elementary and Secondary Schools Subcommittee arguments task force group of ACM´s Curriculum Committee. Book develops Taylor´s three part model of computers uses in schools: tool, tutor and tutee.

Watt, Daniel. *Learning With Logo*. McGraw-Hill.

Excellent book to base a Logo course around. Contains a very imaginative, step by step introduction to LOGO. Is full of graphics, illustrations and ideas. Can be used with various dialects of Logo, such as Apple Logo, Terrapin Logo, TI Logo etc. Watt was closely associated with the Logo development program at MIT.

Broad Reading

Ableson, Harold, diSessa, Andrea. *Turtle Geometry: The Computer as a Medium for Exploring Math.* Cambridge, Mass: MIT Press, 1981.

This book is a computer based introduction to geometry and advanced mathematics at the high school or under graduate level. It covers Turtle Graphics, plane geometry, coordinate geometry, vector analysis, topology and 3-D systems. Ableson, diSessa and Papert were closely associated in the development of Turtle Graphics and LOGO at MIT.

Department of Education. *A Nation at Risk: The Imperative for Educational Reform.* 1983.

Report on the state of the educational system in the US by a committee appointed by the Secretary of Education. It mentions a number of educational problems faced by the US. Document created a lot of controversy, and has been repeatedly attacked by educators.

Department of Education. *What Works: Research About Teaching and Learning.* Pueblo, Colorado: S.James Consumer Information, 1986.

Comprehensive guide for parents, teachers and school administrators. Includes facts and advice on a broad range of topics from home curriculum to teaching techniques to discipline in schools. Free publication. To order, quote ref. no (605P) and write to S James Consumer Information Center Z, P.O.Box 100 Pueblo Colorado 81002.

Dertouzos, Michael, Moses, Joel (Eds.). *The Computer Age: A Twenty Year View.* Cambridge, Mass.: MIT Press, 1979.

An early work by a group at MIT for the US Bicentennial celebrations. Contributors include Papert, Marvin Minsky and Weisenbaum. Authors include (till 1979) two Turing Award winners, two Nobel prize winners. Discusses issues in computing in the 20 years up to 1979, and discuss future trends.

Dreyfuss, Hubert L., Dreyfuss, Stuart E.. *Mind Over Machine: The Power of Human Intuition and Expertise.* New York NY 10022: Free Press, 1986.

Book says that AI hasn't worked and asks why. What can we reasonably expect from computer intelligence? How can we use it? What are the risks involved? Proposes a non mechanistic model of human skill to explain the failure of existing AI systems to capture expert human judgment. Predicts that the failure will continue until intelligence fails to be understood as abstract reason and computers cease to be used as abstract machines. Warns against attempts at too zealous computerization in fields such as education and management. $ 16.95

Figenbaum, Edward, McCorduck, Pamela. *The Fifth Generation: Artificial Intelligence & Japan's Computer Challenge to the World.* Addison-Wesley, 1983.

Non technical description of Artificial Intelligence, and its projected consequences. Describes the Japanese Fifth Generation project, their computers, software and work ethic.

Fullan, Michael. *The Meaning of Educational Change.* New York: Teacher's College Press, 1982.

An excellent book that looks at factors affecting educational change. Based on research and is an excellent source of information for computer educators, who are primarily interested in educational change. Covers

educational leadership, school improvement and inservice training.

Gardner, Howard. *Frames of Mind: The Theory of Multiple Intelligences.* New York: Basic Books Inc., 1983.

Suggests that intelligence is a general capacity or potential which every human being possesses to a greater or lesser extent. Questions the notion that intelligence can be measured by standardized verbal instruments. Formulates a definition of intelligence as the ability to solve problems or to create products that are valued within one or more cultural settings. Introduces eight distinct criteria for intelligence and proposes seven human competences that fulfill these criteria $ 11.95.

Greenfield, Patricia Marks. *Mind and Media: The Effects of T.V., Video Games & Computers.* Cambridge Mass: Harvard U. Press, 1984.

Book looks at the effects of mass media on education. Suggests that we need to redefine our ideas of literacy. Suggests that media can be used to promote social and thinking skills, that each medium can make a contribution to development, that each has its own strengths and weaknesses. Greenfield is professor of Psychology at UCLA.

Naisbitt, John. *Megatrends: Ten New Directions Transforming Our Lives.* New York 10103: Warner Books, 1982.

(from back cover:) Introduces the notions of the ages of man, starting with the agricultural age, through the industrial age, and (what we are now entering) the information age. Suggests the coming decade as a period in which America will shift from industrial production to providing service and information. $ 3.95

Schank, Roger C., with Peter Childers: *The Cognitive Computer: On Language, Learning and Artificial Intelligence.* Addison-Wesley Publishing Co., Reading, Mass., 1984.

A non-technical introduction to artificial intelligence and natural language processing. Schank is one of the leading AI researchers. He is a linguist, and professor of computer science and psychology at Yale University.

Tobias, Sheila. *Overcoming Math Anxiety.* New York: W W Norton & Co., 1984.
Looks at the problems affecting women in maths, science and technical fields.

Suggests that the disparity between male and female performance in math is due to social bias rather than innate ability. Suggests ways to combat this problem. (Note: A similar situation exists with computers.)

Trukle, Sherry. *The Second Self: Computers and the Human Spirit.* Simon & Schuster Inc., 1984.

Weizenbaum, Joseph. *Computer Power and Human Reason.* San Francisco: W H Freeman & Co., 1976.

A controversial book. Weizenbaum was an early AI researcher, who has become one of AI's strongest critics. Weizenbaum wrote a program called Eliza which 'talked' to a user. While not intended as such, the program became acclaimed as a psychotherapeutic tool. Book suggests that automation negatively shapes society, and asks if it (and particularly AI) is necessary.

X Wills, Bernice; Thomas Sheilah; Hoppe, Mike. *Technology & Learning: Changing Minds in a Changing World.* North Carolina: Southeastern Regional Council for

Educational Improvement, 1985.

Fourth volume in a series. Based on data gathered from a conference of educators using high technology teaching techniques. Indicates that technology had arrived early in schools, but that questions regarding effective implementation have to be answered. Suggests that new technologies are changing thought processes. Copies may be ordered from the publishers for $5.

'Fun' Books

Asimov, Issac. *I, Robot.*

One of Asimov's Robot series. Collection of short stories which deal with robots going through succeeding stages of intelligence. In this book, Asimov formulates his now famous "Three Laws of Robotics.

Crichton, Michael. *Terminal Man.*

A story about a computer driven implant in the brain of a disturbed man. This thriller is wrapped up with a lot of facts about computers. There is a very amusing "conversation" between two computers called George and Martha.

Crichton, Michael. *Congo.*

A thriller with lots of facts about computers, learning, gorillas and blue diamonds.

Gonick, Larry. *The Cartoon Guide to Computer Science.* New York New York: Harper & Row Pub Inc., 1983.

A book that can be used to lighten up a computer science course. It contains an accurate, cartoon based, introduction to computer science. It covers in some detail Charles Babbage, Ada Lovelace, the Information Age, Alan Turing, Von Neumann, Shannon Boole, hardware and software. Contains a bibliography. Gonick has two degrees in Math from Harvard and has worked as a FORTRAN programmer.

Journals

Journals keep us in touch with the latest theories and innovations. Journals also form an excellent means of communication, both for ideas as well as problems. It has been estimated [Moursund 86 in the book list] that well read computer educators read between 12 and 15 periodicals regularly.

The journals are divided into three categories: computers, education and computers in education. Computer journals such as Byte, A+, Infoworld and the ACM Transactions of Computer Science deal with computers. In this list, journals dealing purely with computer science have not been included.

Journals whose primary focus is on aspects of education are listed under education journals. Teachers College Record, Educational Researcher and Educational Leadership are examples. Computers in education journals deal with the educational uses of computers. Classroom Computer Learning, Collegiate Microcomputer and Computers and Education fall into this category. This category also includes those journals on instructional technology, whose primary emphasis is computers, such as Educational Technology.

Computer Journals

Name: A+ Call Number: QA76.8.A66A2
Issues per Year: 12 Cover price: 2.95 Subscription price: 24.97
'The independent guide to Apple Computing'. Covers both the Apple II series as well as the Macintosh, with the focus on the Apple IIs.
Contributors: computer professionals
Type of articles: reviews, news.
Audience: owners/users of Apple IIs
Impressions: worth subscribing to if you use an Apple II. Similar to PC WORLD. Refer to PC WORLD for more information.

Name: Byte
Issues per Year: 12 Cover price: 3.50 Subscription price: 19.00
Published by McGraw Hill.
Contributors: computer professionals, university professors, students
Type of articles: two kinds: Theme, and Features. See columns for the others. Theme articles relate to the cover: e.g. artificial intelligence, educational computing etc. Magazine tends to get leaders in the field to write for the theme articles, e.g. Henry Jay Becker and Alfred Bork for the Feb. 87 issue on Educational Computing. Magazine usually covers new developments that it considers major, e.g. the Macintosh II. Magazine also has a dialup conference: BIX and a network: BYTEnet.
Audience: people interested in microcomputers.
Impressions: very well established (12th year of publication), and one of the leaders in the field.
Columns: Byte is divided into seven sections, each of which has its own columns. Features covers articles that would not fit elsewhere, and includes reviews, programming projects, hardware construction projects etc. Theme: articles relating to the cover theme. Reviews: hardware and software reviews. Kernel: the 'standard' columns: Computing at Chaos Manor: discusses computer related issues, Byte UK, Applications Only: According to Webster: (68000 based machines). Mathematical Recreations. Other sections are: Best of Bix and Departments.
Advertisements: hardware manufacturers, software publishers, retailers books, support (media, paper etc.), backpages, index to advertisers.

Name: MACWORLD Call Number: QA76.8.M3.M3
Issues per Year: 12 Cover Price: 3.95 Subscription price: 24.00
Magazine dedicated to the Macintosh. Published by PCW Communications Inc., who also publish PC WORLD.
Contributors: computer professionals
Type of articles: hardware and software reviews, news
Audience: macintosh users
Impressions: good magazine for Macintosh users.
Columns: divided into four sections: Departments, Macworld News, Features and Reviews. Similar to the PC WORLD format. See PC WORLD for more details.
Advertisements: Hardware Manufacturers, Software Publishers, Retailers, Support (media, paper etc.), Books, Backpages, Index to Advertisers

Name: PC Tech Journal
Issues per year: 12 Cover Price: 3.95 Subscription price: 34.97
Subscription price gives 13 issues a year (13th is the PC Tech Journal Directory, published in November.)

Contributors: computer professionals
Type of articles: semi-technical articles dealing with the IBM PC family.
Audience: IBM PC family users with some computer science/hardware background.
Impressions: contains many useful tips, and in depth reviews of hardware/software.
Columns: Directions (trends in PCs), Product of the Month (hardware or software product), Tech Releases (hardware, software, and other developments) Tech Notebook (assembly language tips), Programming Practices, Book Reviews, Expert Computer Consultant, Mail Order, Tech Mart, Calendar.
Advertisements: Same as other computer journals.

Name: PC World Call Number: QA76.8.I2594P3
Issues per year: 12 Cover Price: 2.95 Subscription price: 17.97
Devoted to IBM PCs and their compatibles.
Contributors: computer professionals
Type of articles: reviews, trends in the market, ideas, programming tips etc.
Audience: IBM PC or compatible users.
Impressions: Good magazine for PC-family users.
Columns: Letters, REMark, PC World View, From the Hardware Shelf, From the Software Shelf, The Help Screen, *.*.
Advertisements: same as other computer journals.

Education Journals

Name: Educational Leadership Call Number: L11.E443
Issues per Year: 8 Subscription price: 32.00
Journal of the Association for Supervision and Curriculum Development. (From magazine) "..is intended primarily for leaders in elementary, middle, and secondary education, but is also for anyone interested in curriculum, instruction and leadership." Publications advisory board comprised mostly of university faculty. Magazine is also available on audio cassette tape, $48/yr.
Contributors: professionals (govt., admin., researchers), university faculty, teachers.
Type of articles: well referenced, theoretical articles.
Columns: magazine has a theme for each issue, and most articles are based around that. Theme articles are often written by leaders in the field, which are critiqued, and defended in the same issue. Some issues reviewed had a second theme, put under the title "Contemporary Issues." Other columns: Trends, Voices, Reviews, Letters, ASCD in action and Book Reviews.
Advertisements: Hardware Manufacturers, Software Publishers, Books, Index to Advertisers, Colleges of Education, Conferences/Workshops

Name: Educational Researcher Call Number: L11.E298
Issues per Year: 10 Cover price: 2.50 Subscription price: 15.00
Published by the AERA (American Educational Research Association). Student membership to AERA is only $20 and includes $10 towards the magazine.
Contributors: university faculty, researchers.
Type of articles: theoretical, descriptive. Some attention to computers.
Audience: educational researchers, educators.

Impressions: a good magazine, and quite cheap.
Columns: Computer Network: lists uses of the Educational Research Forum (sponsored by AERA on CompuServe.); Update: information about conferences, calls for manuscripts etc.; Classifieds: job opportunities; Governmental and Professional Liason Report. Magazine carries a lot of information about AERA activities.
Advertisements: Moderate emphasis on advertising: software publishers, books, scholarships.

Name: Harvard Educational Review Call Number: L11.H3
Issues per Year: 4 Cover price: 10.00 Subscription price: 28.00
Published by Harvard University, edited by students.
Contributors: teachers, university faculty.
Type of articles: descriptive, mostly well referenced, some use footnotes and no bibliography. Some issues are 'special issues' e.g. a special issue on 'Teachers, Teaching and Teacher Education.' Little focus on computers in education.
Audience: researchers, teachers.
Impressions: descriptive articles, little quantitative research.
Columns: Essay Reviews: reviews of four or five books presented in the form of one essay. The books tend to be about the same subject. Book Reviews, Book Notes.
Advertisements: low emphasis on advertising.

Name: Phi Delta Kapan Call Number: LJ121.P4
Issues per Year: 12 Cover price: 2.50 Subscription price: 20.00
The journal of Phi Delta Kappa.
Contributors: professionals, university faculty.
Type of articles: educational research, service, and leadership. Issues, trends and policy are emphasized.
Audience: educators.
Impressions: quality articles, one of the older and better respected magazines in education. No computers in education articles in the 6 consecutive issues (Sept. 86 - Jan. 87) reviewed.
Columns: Features: articles on the cover theme Editor's Page, Washington Report: Opinion/news from author based in Washington; Stateline: News from different states; Research: news about research; De Jure: Legal aspects of education: focuses on current cases in the courts; Prototypes: News about new programs; Books: Book reviews, each month covers a different topic, e.g. teachers, moral education, teaching of writing; Newsnotes: news; Backtalk: readers' comments.
Advertisements: hardware manufacturers, software publishers retailers, support (media, paper etc.), books, backpages, colleges of education, conferences.

Name: Teachers College Record Call Number: L11.T4
Issues per Year: 4 Subscription price: 20.00
One of the oldest and most respected journals in the field of education. First issue was in 1890. Published by Teacher's College, Columbia University.
Contributors: university faculty.
Type of articles: theoretical.
Audience: researchers, teachers.
Impressions: high quality articles covering a wide range of topics in

education. Some emphasis on computers in education.
Columns: some issues have a theme, and these have a covering article called 'For the Record'. Regular columns: Book Reviews: detailed reviews; The Reading Shelf: more reviews; Contributors: biographical notes about contributors.
Advertisements: Books, Journals.

Computers in Education Journals

Name: Classroom Computer Learning — Call Number: LB1028.43.C53
Issues per Year: 8 — Subscription price: 15.95
Contributors: teachers, editorial staff.
Type of articles: descriptions of new technology/techniques, suggestions of what to do in classrooms, program listings. No research articles. Lot of reviews of software, lot of tables comparing hardware and software.
Audience: classroom teachers.
Impressions: fun magazine.
Columns: Features (e.g.: How Have Software Companies Helped You Lately?, 1987-88 Buyer's guide, The Archival Videodisc, How large-Screen Projectors Put the Teacher Back into Teaching); Software Reviews; Classroom Activities; Message Board: Information Swap for Educators; Newsline: nationwide developments (policies, trends etc.); Q & A: Answers to technical queries; Letters: Reader's Comments; Dates & Events: Computer conferences and shows; Industry News: Promotions, contests and latest happenings; What's New: New hardware, software and publications.
Advertisements: hardware manufacturers, software publishers, Retailers, support (media, paper etc.), Books, Backpages, Index to Advertisers

Name: Collegiate Microcomputer — Call Number: LB1028.43.C63
Issues per Year: 4 — Subscription price: 28.00
Contributors: university professors.
Type of articles: areas related to the use of microcomputers in the college or university environment.
Audience: college educators interested in using computers in their work.
Impressions: covers a wide variety of topics, without any clear focus. A number of the articles deal with educational uses of micros, and are written by professors who are neither computer scientists, nor educators.
Columns: no regular columns.
Advertisements: software publishers, retailers, support (media, paper etc.).

Name: Computers & Education — Call Number: LB2846.C578
Issues per Year: 4 — Cover price: 38.75
Printed in the UK: a very expensive journal. Annual subscription is $155, though individuals may by an additional copy at $45. Four issues reviewed: all four of 1986. First issue: selected proceedings from the CAL '85 Symposium held at the University of Nottingham. Papers discussed a very wide range of CAI/CBL/CAL topics. (Interactive video, disabled education, introduction of computers into schools etc.).
Contributors: university professors, students etc., from both the UK and the US, and other countries, and a large number of people associated with various government organizations.

Types of Articles: research, descriptive.
Audience: teachers, educators, computers in education researchers.
Impressions: an impressive journal.
Columns: book reviews.
Advertisements: little emphasis on advertisements.

Name: Computing Teacher, The Call Number: LB1028.5.C667
Issues per Year: 9 Cover price: 3.50 Subscription price: 21.50
Journal of the International Council for Computers in Education.
Contributors: university professors, teachers.
Type of articles: research, practical, opinions. Have bibliographies.
Audience: computers in education practitioners, also useful to researchers.
Impressions: magazine is not researched based, but contains ideas and information useful to both researchers and practitioners.
Columns: organized into three sections: Features, Departments and Columns. Features: (examples) policy regarding software preview centers, word processing and curriculum renewal, assessing learning with Logo: a pilot study. Columns: software reviews, software releases, research windows, the logo center, computers in the language arts, computers in the math classroom.
Advertisements: hardware manufacturers, software publishers, support (media, paper etc.), books, index to advertisers.

Name: Educational Technology Call Number: LB1027.E3
Issues per Year: 12 Cover price: 7.50 Subscription price: 69.00
Published by Educational Technology Publications, who publish books on educational technology. (See the advertisement section.)
Type of Articles: software quality, interactive videodisc, CAI, CMI, software applications, (PFS:FILE, dBASEIII), word processing, computer languages. Seeks papers on themes. For example, AI was a recent theme. Lot of attention to interactive video.
Contributors: university professors, students, professionals.
Impressions: good reference material.
Columns: Technology News: A Monthly Column of News and Commentary; Instructional Design; The Eclectic Technologist; Professional Literature Review; Events Calendar; New Products, New Services; Product Reviews; ERIC Reports.
Advertisements: Books (mostly published by parent company) with their reviews. E.g. Messages that work, The Well Trained Computer, Selecting Media for Instruction.

Name: Electronic Education Call Number: LB1028.46.E4
Issues per Year: 8 Cover price: 3.50 Subscription price: 18.00
Contributors: wide range, mainly staff, some university professors, teachers, coordinators etc.
Type of articles: semi-research based, informative, discuss trends and issues.
Audience: teachers, computer coordinators.
Impressions: good magazine.

Name: Journal of Computers in Math & Science Teaching,
Issues per year: 4 Subscription price: 18.00
Published by the Association for Computers in Mathematics and Science

Teaching. Subscription includes membership.
Contributors: school educators, university faculty, researchers.
Type of articles: descriptive (programs etc.).
Audience: science teachers, computer educators.
Impressions: practical articles.
Columns: divided into Features, Columns and Departments. Features: articles discussed above. Columns: computer literacy, conference abstracts, BASIC tools, learning with LOGO, bibliography, research notes.
Advertisements: limited advertising: software publishers.

Name: Journal of Computer-Based Instruction Call Number: LB1028.5.J613
Issues per Year: 4 Subscription price: 18.00
Published by the Association for the Development of Computer-Based Instructional Systems (ADCIS).
Contributors: university faculty.
Type of articles: descriptive, research.
Audience: researchers in computer-based instruction.
Impressions: good journal. Articles are technical, and are mostly based on specific CAI programs.
Columns: some issues are based around a theme (1 in 5 reviewed). Mostly unrelated articles. Other columns: book reviews, ERIC research abstracts.
Advertisements: only about ADSICS membership.

Name: Journal of Educational Computing Research Call Number: LB1028.5.J68
Issues per year: 4 Subscription price: 85.00
From inside cover: The Journal of Educational Computing Research publishes original, refereed articles on important empirical research, conceptual and theoretical analyses, design and development studies, and critical reviews. Included are: outcome effects, design and development of innovative hardware and software, interpretations and implications of research in educational computing and related fields, theoretical and historical foundations. The Journal is dedicated to advancing knowledge and practice in the field. In addition, the journal serves as a forum for professional dialogue by publishing correspondence, grant listings, research notes and reviews.
Contributors: university professors, professionals.
Type of articles: see description below.
Audience: computers in education researchers.
Impressions: contains a lot of 'hard' research. The editorial board has some very prestigious names, such as Alfred Bork, Seymour Papert and Joseph Weizenbaum. Very expensive.
Columns: Book Reviews: journal often publishes two reviews of the same book, showing different points of view. Grants listing: list of grants to educational computing programs. Research notes: notes about who is doing what in the field. Includes contact addresses.
Advertisements: Other journals.

Name: Journal of Educational Technology Systems Call Number: LB1028.3.J68
Issues per year: 4
Official publication of the Society for Applied Learning Technology. Institutional subscription is $75. Individual subscription was not indicated. Editorial Board: university professors, professionals. Published by Baywood, who also

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publish the Journal of Educational Computing Research. Formats are very similar.
Contributors: university faculty.
Type of articles: theoretical, research, descriptive. All the articles reviewed were about computers. (12 articles, from 4 issues).
Audience: educators interested in using computers, computers in education researchers.
Impressions: good magazine, but this researcher preferred Baywood's other publication.
Columns: Editorial overview: summarizes the articles.
Letter from the President: society news.
Advertisements: low emphasis on advertisements.

Name: SIGCUE
Issues per Year: 4 Cover price: 4.00 Subscription price: 20.00
Published by the SIGCUE (Special Interest Group on Computer Uses in Education) of the ACM (Association for Computing Machinery).
Contributors: university faculty. Many of the pioneers of CIE write for this. Contributors include Beverly Hunter, Alfred Bork and Robert P Taylor.
Type of articles: descriptive. Some issues are based around themes such as national educational computer policy alternatives, computer education for colleges of education, etc.
Audience: computer educators.
Impressions: excellent magazine.
Columns: Editor's message, calendar of events and notices, book reviews, SIGCUE bibliography of computer uses in education. The last column is extremely useful for someone doing research.
Advertisements: low emphasis on advertising. Mainly ACM notices.

Name: T.H.E. Journal Call number: LB1028.3.J69
Issues per Year: 6 Cover price: 3.50 Subscription price: 29.00
(Technical Horizons in Education) Free to qualified individuals in educational institutions and training departments in the USA and Canada. Refer subscription card in the magazine.
Contributors: university professors, professionals (educational laboratories, administrators, educational technology consultants).
Type of articles: theoretical.
Audience: professionals in computers in education, consultants, teachers and researchers.
Impressions: a good magazine for keeping in touch with new developments, as well as has good journal articles.
Columns: Technology Update, New Publications News, New Products, Directory of Hard disks /word processing/ courseware etc. Software & Courseware, Calendar, Applications.
Advertisements: hardware manufacturers, software publishers, retailers, support (media, paper etc.) books, backpages, index to advertisers.

MECC APPLE SOFTWARE IN THE EUGENE SCHOOL DISTRICT

By Patti Nelson

I. Introduction

The goal of this presentation is to share with you the success of using the MECC Apple software in the Eugene School District. I have based my presentation on the assumption that you haven't yet heard about MECC software and support materials. The program titles, grade levels and type (drill and practice, tutorial, or simulation) will be shared with you.

The MECC software shared with you is also based on what the 4J School District has in the Magladry collection. This doesn't yet include some of the new releases from the Fall of 1986 and Spring of 1987.

The presentation focus is on the programs that will enhance learning with a computer, rather than learning about the computer. Hopefully this will introduce you to the capabilities of the software and the instructional objectives. The goal of the software should be to help a student learn how to create their own "new" information, increase mental flexibility and "sifting" of pertinent or factual information, i.e. intellectualizing abstract concepts.

With software acquisition budgets low, MECC is a solution to the problem. For the cost of becoming a member and receiving a copying license through OECC, a school district or ESD can purchase a majority of MECC's programs at $5.50 per disk and $3.25 for the documentation. Then it is a matter of someone's time to duplicate the programs for

in-district use. The MECC/OECC license agreement allows for the making of as many copies as are desired.

For the 1986-87 school year the Eugene School District paid $1,500 for the MECC/OECC agreement. As of March 5th, 1,500 copies of program titles had been made. This works out to be $1 per copy, or an average of $37.50 for each school (there are 42) to have copying rights and as many copies as they wanted.

To emphasis the MECC availability in the District, it was decided by Jack Turner, Eugene Computer Coordinator, to have a MECC o' the Month: a program disk and documentation would be copied and sent to each school to encourage collection building at the building level. The purpose was to introduce the possibility of having other MECC programs. Titles selected for the MECC o' the Month came from teacher interest in a computer program. At the end of June 1987, Magladry had made 2,000 copies of various MECC titles.

The in-district Computer Reps Newsletter announced the arrival of new programs and had several articles on MECC programs or collections, i.e., the Mastering Math Series, throughout the school year.

II. Credible Classroom/Educational Use of Computers

Educators have found that computers can help do several things in the classroom. Computer time can enhance student learning time for basic skill for mastery or for reinforcement, motivation for reluctant learners, presenting problem solving strategies and higher order

thinking skills, and supplement teacher time for remediation or enrichment. It has also been found that writing and composition skills are enhanced when using a word processor and spelling checker.

First, let's review several teacher/management options that "good" programs can/should have:

- o ability to add/change the content
- o difficulty levels
- o ability to vary response time and/or sequence presentation
- o selection of number of problems and/or number of users
- o turning on/off of graphics or sound
- o recordkeeping capability - this allows a student to work independently and save scores for the teacher to look over later

These are conveniences and make a program more versatile for a variety of users.

For purposes of clarification, another item to discuss is the uses of tutorial, drill and practice and simulation to a describe the presentation mode of a program. A tutorial presents information in an introductory manner to prepare the learner for skill building; a drill and practice program reviews the skill building by asking for recall of facts or information in sequence of difficulty; and a simulation presents information or an experiment in an active manner i.e., a science lab experiment.

Two excellent resources from MECC that will help you implement the MECC software into your classroom are: Integrating Computing into the Curriculum, and, Using the MECC Computing and Information Collection, a

teacher's guide. The objectives of both of these resources is to give supplemental support materials and activity ideas for various curriculum areas and grade levels. Some MECC support materials are for on-going non-computer activites as lead-ins, direct instruction or follow-up.

MECC also supplies: 1) program descriptions, 2) objectives, 3) on-disk preview of how to run a program and its options, and, 4) lesson planning and support materials in the documentation of each program. In most of the new MECC software an all important command to remember, because it is not in #3 above, is Control A. This disk accesses the teacher management options of sound/graphics on/off, game speed, student scores, etc.

III. The List

Addition Logician
Adventures With Fractions
Arithmetic Critters
Circus Math
Classification
Clock Works
Computers In Government
Create-a-Base
Discovery Lab
Early Addition
Elemenatry Vol. 1 through 12
English: Parts of Speech
Estimation
First-Letter Fun
Food Facts
Friendly Computer
Fun From A to Z
Ghost Writer
Grade Manager
Growgin's Fractions
Jenny's Journeys
Labels, Letters, and Lists
Mastering Math Diagnostic System
" " Management System
" " Worksheet Generator
Market Place
Math Volumes 1, 2, 3, and 4
MECC Dataquest: Fifty States
MECC Dataquest: The Presidents
MECC Editor

MECC Graph

MECC Graphing Primer

MECC Information Manager

MECC Keyboarding Primer

MECC Keyboarding Master

MECC Speller

MECC Stuff 'n Fetch

Mind Puzzles

Mouse in the Maze

Multiplication Puzzles

Nutrition and Food Groups

Oh! Deer

Oregon Trail

Paint With Words

Problem-Solving Strategies

Puzzles and Posters

QuickFlash

Quotient Quest

Right of Way

Science Volumes 3 and 4

Sky Lab

Smoking: It's Up To You

Space Subtraction

Student Stories

Study Guide

Subtraction Puzzles

Teacher Utilities Vol 1, and 2-4

Word Herd: Look Alikes

Word Herd: Sound Alikes

Word Munchers

Word Wizards

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Pollard, Gerald. The Price is Right: Free and Inexpensive Resources. The Computing Teacher. February 1987, p. 30.

Truett, Carol. The Computing Librarian: Shrinking Software Budget? Public Domain Software May Be The Answer. The Computing Teacher. June, 1987, p. 46.

COMPUTER GRAPHICS APPLICATIONS FOR TEACHERS

Julie A. Poage

The use of computer graphics in the classroom provide an exciting teaching media and a motivating learning environment. Students can express their creativity while they are exposed to an advanced technological tool. They can easily manipulate data to represent complex concepts in a visual form, or make simple changes to exsisting graphics to form new and exciting images. Teachers utilizing computer graphics are able to produce high quality diagrams for instructional uses, while over time reducing tedious preparation.

Student Applications of Computer Graphics

In the past, most students have used computers as "toys". They are eager to sit in front of a computer monitor and play with simple drawings they have produced using a mouse or KoalaPad™. It is often difficult to utilize these playful activities into constructive educational lessons. But, with some thought, creative and interesting computer graphics lessons can be designed for use with some of the most popular computer graphics software.

The Print Shop™

The Print Shop™ (from Broderbund) has become one of the most popular pieces of computer software in any school's collection. It is very simple to use and produces pleasant and practical computer graphics.

Broderbund has upgraded The Print Shop™ several times since its debut in 1984. The most recent edition of The Print Shop™ takes advantage of the color printing capabilities of several color printers. With the new color edition, graphics, borders, and fonts can be printed in varying colors. The newer edition of The Print Shop™ also allows the user to preview and save their creations.

Using the Graphic Editor of The Print Shop™, students are able to create their own graphic images and then use them in greeting cards, letterheads, signs, or banners. Using this option students could be asked to design their own stationary, creating a personalized graphic that represents their personality. In the Sign mode students can create attractive cover pages for research papers. Or, as an addition to a poetry unit, students could illustrate an original poem, or print examples of their favorite poet's work. The printed poetry could then be arranged to make

an attractive bulletin board.

Dazzle Draw™

Dazzle Draw™ (by Broderbund) is a wonderful graphics tool for the Apple IIe. It produces double high-resolution graphics, utilizing 16 colors and an infinite number of patterns. Using Dazzle Draw™ students are able to create original computer graphics that can be printed in color on the Imagewriter II or Epson JX-80 color printers.

Dazzle Draw™ provides a wonderful medium for the art classroom. Single frame images can be created in the style of the impressionists, or students can arrange up to six Dazzle Draw™ images into a self-running slide show. Slide shows can be produced to express emotions, hot and cold color groupings, or to demonstrate the elements of design (Berkson & Poage, 1986).

Animate™

Animation using the Apple IIe is not a simple task, but using a commercial animation program such as Animate™ (from Broderbund) students can create animated sequences with minimal effort.

Animation can be used in a wide variety of educational settings. It can be used to illustrate the elements of film or video recording, or as a demonstration tool in areas such as science or social studies. Imagine the understanding a student would possess after creating an animated "movie" of mitosis (simple cell division), or the proposed movement of the continents in the study of plate tectonics. After studying the evolution of man a student could present the proposed stages of the human species, blending one species easily into the next using animation. In the physics class, students could present examples of simple machines and their operation could be animated to define work, efficiency, force, and vectors.

The Newsroom™

The newpaper is used as an instructional tool in many classrooms. But, why should students be limited by the news that is presented in local or nationally published newpapers? Using The Newsroom™ (from Springboard) students can create their own newpapers within almost any classroom environment. In addition to creative writing activities, The Newroom™ also allows students to create their own graphics, or make adaptations to exsisting graphics.

Science students studying prehistoric times might produce a

newspaper with descriptions and pictures of dinosaurs. History students might research the news events and styles of a time in U.S. history, such as pre-revolutionary war Boston, and produce a newspaper as it might have appeared in 1770 (the year of the Boston massacre.)

Story Maker™

Creative writing and computer graphics can easily be combined to produce exciting student work. Story Maker™ (from Sierra On-Line, Inc.) allows students to create stories and illustrate them using their own computer graphics. Students write and edit their work then insert graphics that they have drawn and colored. When the graphics and writing are combined and saved on a data disk, the students have a computerized storybook that runs automatically.

Computereyes™

Computereyes™ (by Digital Vision) is a computer interface that connects a video camera to your computer. Using Computereyes™ students can "capture" video images and save them for use with a wide variety of computer software.

Combining Computereyes™ images and The Newsroom™ students can incorporate "photos" of teachers, students, or other famous people in their newspapers. Using Dazzle Draw™, art students can use self-portraits taken with Computereyes™ and edit them to produce amazing results. Students could make t-shirts with Computereyes™ images and print them with heat transfer ribbons. Computereyes™ images can even be used in Print Shop™ cards, signs, letterheads, or banners.

Teacher Applications of Computer Graphics

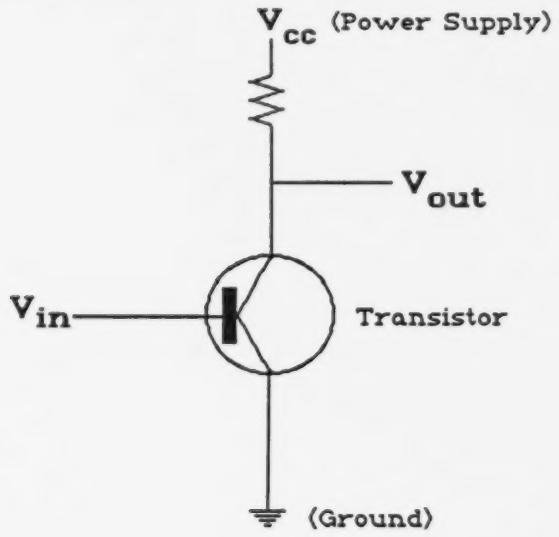
While students enjoy creating computer graphics, teachers will find that graphics can improve their presentations and increase the interest of many of their students. Tools such as Certificate Maker™ and Superpaint™ or MacPaint™, can be used to prepare awards, handouts, or overhead transparencies. Programs like Microsoft Works™ can be used to represent data in a graphical form which provide students with an alternative learning style when faced with a complex concept.

Certificate Maker™

Teachers are always searching for simple ways of improving student motivation, whether it is for improved arithmetic scores or the most books read in a month. Using Certificate Maker™ (from Springboard) teachers can use personalized awards to acknowledge student improvement or success.

SuperPaint™ and MacPaint™

Superpaint™ (Silicon Beach Software) and MacPaint™ (Apple, Inc.) are graphics programs for use on the Macintosh computer. They provide a simple means of creating high quality computer graphics. Complex diagrams can be reproduced and then edited as needed. Imagine the geography teacher that has a graphics library of the countries around the world. As students progress through history lessons the teacher can produce maps illustrating changing boundaries, or highlighting those nations with democratic governments.



Anotomical diagrams of earthworms, crayfish, or frogs could be produced that trace the digestive, circulatory, reproductive, and nervous systems of each animal. Circuitry diagrams can be assembled from components that are saved in the "scrapbook."

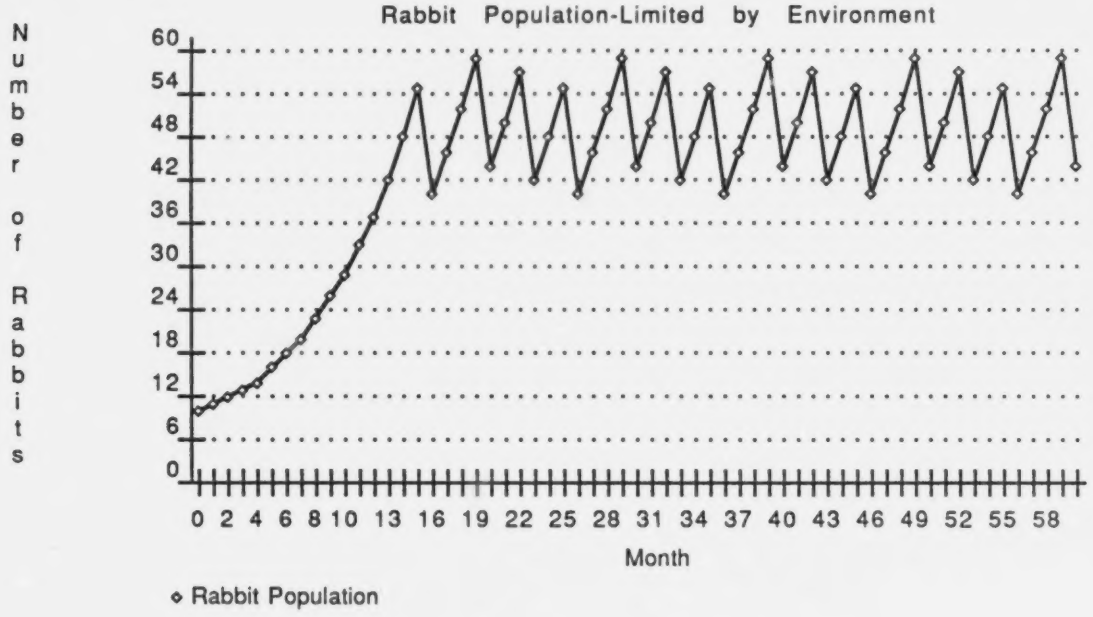
Textbook drawings or photographs can be reproduced using Thunderscan™. Thunderscan™ installs on an Imagewriter printer and digitizes printed images for use with MacPaint™ or SuperPaint™.

Microsoft Works™

Microsoft Works™ (from Microsoft) is an integrated word processor, database, spreadsheet, and telecommunications program for the Macintosh computer. The spreadsheet option of MS Works™ also features a means for graphically representing data. Data in the spreadsheet can be drawn as a line graph, a bar graph, or a

pie chart.

By presenting data in a spreadsheet and then drawing graphs to represent the data, students are able to "see" complex concepts such as limiting factors affecting a rabbit population (see diagram), or changes in economic structures of a nation (i.e., imports vs. exports over time.)



Conclusion

The applications of computer graphics are limitless. Graphics can easily be incorporated into the art curriculum or as learning tools in other content areas such as science, social studies, or language arts. With advancements in computer technology, students are now able to create animated graphics as well as still images. Teachers will find that computer graphics add tremendously to their presentations and handouts, and can even save time and energy as they develop extensive graphics libraries. As computer applications continue to find their way into education, computer graphics will play a large role in the changing ways that students learn and teachers teach.

References and Suggested Readings

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PEER CONFERENCING, COMPUTERS, AND PERSUASIVE WRITING: A RECIPE TO ENCOURAGE REVISION

Jane M. Ritter

The marriage of computers and writing instruction has received the blessings of many, including teachers of writing, developers of curriculum, and designers of computer hardware and software. Although research on the effects of children's use of word processors to write and revise continues to produce variable results, it is still commonly accepted that "computers are, or will be, the means by which our students will produce most of the formal writing they do as their productive careers span into the 21st century" (Bridwell & Duin, 1985, p. 116). This belief is reflected in curricular changes being adopted at schools throughout the country that introduce strands in keyboarding skills and the use of word processors.

If word processors are to be successfully incorporated into the elementary writing curriculum, then the goal of research in this area must be to identify strategies that take best advantage of the technology to effectively instruct children as they write. One must first have an understanding about the processes involved in writing and then determine how the word processor might be incorporated into writing instruction to facilitate those processes. Insight into these processes is gained by examining various models of the writing process.

Models of the Writing Process

Several models of the writing process have been proposed to identify the subprocesses of writing and to describe the interaction among those subprocesses. They generally fall into one of two groups: linear stage models and recursive process models.

Linear stage models describe the writing process as a linear series of stages through which writers pass as they approach completion of a written product (Britton, Burgess Martin, McLeod, & Rosen, 1975; Rohman & Wlecke, 1964). These stages include

prewriting (planning), composing (writing), and revising (editing).

Recursive process models describe a recursive interleaving of the writer through many subprocesses, including planning, remembering, generating, monitoring, reviewing, evaluating, and revising (Flower & Hayes, 1981; Graves, 1975; Nold, 1981). In the recursive models, subprocesses can occur simultaneously or can interrupt any other subprocess at any point during the act of writing. Recursive models reflect the current shift in emphasis from product to process in writing instruction. Although revision is named as a subprocess in both linear and recursive models, its definition varies greatly between the two types of models.

The Subprocess of Revision

In the linear models of the writing process, revision is presented as the final stage of the process and consists of the editing of surface features of the text to correct errors. In recursive models, revision can occur at any time and can interrupt any other process. Revision in this context involves reviewing, evaluating, and changing content and ideas. It requires that the writer detect and resolve discrepancies between what has been written, or the in-process text, and a set of abstract representations of goals and plans for the finished product, or the intended text (Bryson, Lindsay, Joram, & Woodruff, 1986).

The process approach to writing, currently employed in many writing classrooms, is based on recursive models of the writing process. Teachers who employ a process approach encourage children to continually review their writing and revise as necessary. For young writers, however, revision is a skill that does not come naturally (Pufahl, 1984). Revision must be taught.

All revisions are outcomes of evaluations (Flower & Hayes, 1981). According to Hilgers (1984), successful revision results from "a series of correctly made evaluations that result in a 'yes ... continue' decision ... coupled with correctly made evaluations that result in a 'no ... change' decision" (p. 367). The writing conference has been widely used as one method to elicit evaluations and to motivate revisions.

The Writing Conference

During the ideal writing conference, the writer and his or her teacher orally discuss the piece of writing, exchanging ideas about how the text might be interpreted, where problems might exist, and how those problems might be resolved. Recent research on conferencing reveals, however, that typical teacher-student conferencing tends to be a unilateral communication dominated by the teacher (Florio-Ruane, 1986; Freedman & Sperling, 1985). The content and direction of the conference depend on how closely the student's text already matches the teacher's schema for the topic being written about (Michaels, Ulichney, & Watson-Gegeo, 1986).

Although a certain amount of control by the teacher is necessary to impart new information during instruction, too much control may result in a loss of ownership by the writer over the piece of writing. Students quickly begin to form hypotheses on what the teacher wants to see in their writing and then write for the teacher to evaluate rather than to communicate their ideas (Dyson, 1984). In other words, the student writer "throws the teacher a bone to pacify him, knowing full well that his theme does not at all represent what he can do" (Moffett, 1983, pp. 193-194).

One solution to the problem of teacher dominance is the use of peer group conferences in which a group of peers collaborate to discuss and evaluate each other's writing. Peer conferencing has become an established pedagogical method in many writing programs and has been promoted by many writing specialists (Calkins, 1980; Flynn, 1984; Freedman, 1981; Graves, 1983). The group interaction supplies the writer with the necessary feedback and reflects the variety of opinions and interpretations that exist within a group of readers. The teacher can continue to monitor the group conferences, actively participating from time to time to model appropriate conferencing techniques and to introduce new evaluative criteria.

Another problem with many writing conferences is that the writer simply forgets much of what was discussed during the conference and often incorporates only what was discussed at the end

of the conference. Some teachers suggest that children maintain lists during the conference to remind themselves of what was discussed.

Computers and the Writing Process

One major problem associated with the writing process still needs to be addressed: the tedium of the recopying that is necessary to incorporate revisions and still produce a legible paper. Recopying hand-written text is a tedious burden that discourages writers from revising substantially (Shaugnessy, 1977). This aspect of the writing process is the one most often mentioned when touting the advantages of using computers to write.

The computer does indeed eliminate much of the tedium associated with the recopying that is a necessary part of revising. It provides children with a tool to easily insert, delete, and move text. "Not having to re-copy helps writers to compose freely, focusing on what they want to say ... the ease of revision encourages writers to experiment and to view their writing as dynamic" (Daiute, 1983, p. 139).

Nonetheless, expectations of computers in the writing process have been unreasonably high. One cannot expect children who have little or no experience with revising to spontaneously take advantage of the word processing functions that facilitate revision (Bridwell & Duin, 1985; Pufahl, 1984). One cannot focus on the computer alone, isolated from the context in which it is used. Recent research concludes that the instructional methods used to teach writing determine to what extent student writers make use of the word processor (Collier, 1983; Evans, 1986; Sommers, 1985).

It seems then that the ideal situation in which to teach revision is one which motivates students to write and revise by providing a genre of writing that inherently demands revision, a variety of feedback about what they have written, a method for remembering the feedback, and access to tools that make revision operations easy to perform. The computer plays a role in all of these when one employs a computer-facilitated group conferencing technique with children who are doing persuasive writing.

A Computer-Facilitated Group Conferencing Technique

Using computer-facilitated group conferencing, the writer and a group of conferencers, sometimes including the teacher, gather around the computer to read and discuss a piece of writing. The writer first reads his or her text aloud with no interruptions from the group. Next, group members provide the writer with feedback, focusing on the content of the writing. Questions and comments ought to emphasize such things as completeness of ideas, clarity, logical organization, and effective word choice. Surface features such as spelling and punctuation must be addressed only if they interfere with the meaning of the text. Compliments should be voiced along with suggestions.

In addition to orally discussing the piece of writing, paraphrased conference comments are also typed directly into the text at an appropriate point. The appropriate point is determined by the writer and the student who made the comment. The writers themselves paraphrase the comments into brief phrases that are sufficient to remind them of the discussion that occurred during the conference. This method provides the writer with an abridged record of the conference discussion as well as indicating where revisions might be placed. More importantly, the oral interaction during the conference and paraphrasing of comments by the writer increases the involvement of the writer in the writing process.

Persuasive writing is an excellent domain in which to teach this method. Afflerbach (1985) found that sixth and seventh-grade children who were assigned informational reports of a persuasive nature were much more likely to revise than if the reports were purely informational. Following peer group conferences, these students felt a need to gather more information and revise their papers to defend their positions. Students who once approached revision with "funereal enthusiasm" began to view revision as a purposeful part of the writing process.

Many questions have been asked about the effectiveness of children's use of computers to write and revise. Does the computer influence the way children write and revise? Does the computer

encourage children to use more sophisticated revision strategies than they would normally use with pencil and paper? Does the computer affect children's perceptions or attitudes about writing and revising? Does the computer have an effect on the quality of writing that children produce? It has become clear that it is insufficient to ask those questions about computers in isolation from the context in which they are used. Those same questions must be asked about computers as components of a sound teaching technique. One such technique is computer-facilitated group conferencing.

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EFFECTIVE KEYBOARDING INSTRUCTION: A COMPARISON OF THREE PROGRAMS

Linda Schellenger

The advertisement says this program will solve your keyboarding problems! While the program may run correctly and make excellent use of graphics, previewing a program as complex as keyboarding software may not give enough information to determine if the program effectively presents the objectives of instruction in keyboarding.

What should be the objectives of keyboarding instruction? And, how can it be determined if students are learning what it appears the program is teaching?

What factors are crucial in implementing a keyboarding curriculum? How can students' progress at the elementary or middle school level be evaluated effectively?

In the schools' effort to respond to the concept of the Information Age, additional emphasis has been placed upon computers and their potential within the classroom. However, a curriculum may have been rapidly developed, with little regard concerning skills required of students before beginning extensive, or even moderate, use of the computer. With the increase in the number of computers in home and educational settings and the availability of "user-friendly" software, the opportunity for students to develop incorrect keyboarding habits has also increased.

Reasons for Developing the Field Study Project

When the Language Arts Department of Armand Larive Junior High School in Hermiston, Oregon, reviewed their goals and objectives in terms of the strong interest in computers evidenced at both the elementary and high school levels within the District, it was determined a long-range plan for integrating the use of computers in the writing process was essential. The design of the plan should not only allow students to write more; it should encourage them to write more.

Based on the observation of students at the elementary and junior high levels who were already using a word processor, the lack of keyboarding skills seemed an obvious stumbling block in the process of writing. If keyboarding and learning the use of a word processor were incorporated into the computer literacy elective for 7th grade students, the Language Arts staff would be

able to concentrate their time with students on the process of writing.

Philosophically, keyboarding would be considered an important skill to develop. However, it would not become the focal point of a curriculum, but would provide instead the means for a student to reach the content area objectives within the curriculum.

The following considerations, then, became the focus of a review of the literature and the resulting field study project:

* Is the use of tutorial keyboarding instruction using a computer effective in teaching keyboarding skills?
* What factors need to be considered in implementing keyboarding instruction?

Defining the Terms

Keyboarding focuses on the techniques necessary to develop efficient touch typing skills using an electronic keyboard. Instruction in keyboarding stresses touch typing technique first, then speed, and finally, accuracy of copy. Technique refers to "the position of the student, from the feet to the curved fingers. It includes the movement of the fingers and manner of striking the keys..." (Fidanque, Smith, and Sullivan, 1986) Software programs and research that has been conducted so far seem to reflect this approach. Effort is concentrated on the technique used in inputting information, rather than on the standards for the creation of a product.

Role of the Keyboarding Instructor

The role of the instructor in keyboarding will differ from the "teaching" role in the classroom. With touch typing skills presented through the use of a software tutorial, the teacher becomes more a manager of instruction, rather than the source of instruction. This provides the teacher more freedom to observe and individually correct improper fingering, posture, or speed techniques.

Additional responsibilities of the keyboarding instructor will focus on the development of an integrated curriculum, and the selection of materials for use in teaching touch typing skills. Once students have acquired touch typing skills, continuous and consistent reinforcement is essential. This will require a strategy which provides review of touch typing

skills each succeeding year, in an effort to maintain and improve upon initial learning.

Description of the Field Study Project

Purpose

The project compares the effectiveness of three programs developed for tutorial keyboarding instruction using a computer. A pretest/posttest research design was used, with touch typing rates of 7th grade students providing the measurements for comparison.

Course Description

"Keyboarding" is a 7th grade nine-week elective course in which emphasis is placed on participation; grades are Pass/Fail. The curriculum includes an introduction to touch typing techniques (body position, appropriate keystroking and finger reaches), word processing, and general computer awareness topics.

Population

Seventh grade students from Armand Larive Junior High School in Hermiston, Oregon, participated in the project.

Hardware

A classroom instruction area was combined with a computer lab of 14 Apple IIe systems and four printers.

Software

* "MICROTYPE: The Wonderful World of PAWS", South-Western Publishing Company
* "Introduction to Touch-Typing for Elementary Schools", John Stoecker, Eugene, Oregon, used in conjunction with
  "Bank Street Writer", 1983 version, Scholastic Incorporated
* "MECC Keyboarding Primer", Minnesota Educational Computing Corporation

Management for Keyboarding Goals

Students used the computers for keyboarding instruction for 20-25 minutes per day, four to five days per week, for a period of six weeks.

Procedure

Students were divided into three groups; each group was then assigned a keyboarding tutorial program. An initial sample of handwriting speed was obtained with a 1-minute timing of sentences, with students instructed to use "normal, neat handwriting skills".

A pretest was then given to measure the level of individual and group skill prior to keyboarding instruction. The pretest was composed of three sections: personal/attitudinal information, a blank keyboard on which students filled in letters they knew, and a paragraph for a 5-minute timing at the computer keyboard.

Each of the programs for keyboarding instruction was used as suggested by the accompanying manual. Students in each group were allowed only the use of materials prescribed for their program. No special consideration was given to any classification of student, i.e., learning Disabled or Talented and Gifted.

Following completion of each lesson, two 1-minute timings were administered. There was no emphasis placed on speed; students were instructed only to report their scores accurately. Students recorded the numbers of words and errors for each timing on a progress sheet. The best score of the timings was used, then, in the statistical analysis.

Upon completion of the unit of lessons, a posttest (a blank copy of the original pretest) was administered to each student.

Results and Recommendations

All students' posttest scores increased over initial pretest scores.

All students, regardless of academic ability, increased at approximately the same rate, an average of five words per minute based on a 5-minute timing. Classroom observation of students noted that Learning Disabled students were successful due to the sequential format of the touch typing instruction. Talented and Gifted students found the drill and practice aspect tedious, but were willing to continue because they understood the importance of learning to keyboard prior to word processing.

Male and female learners are equal in their capacity to learn keyboarding skills.

Software tutorials used **under direct teacher supervision** did increase the keyboarding rates of students. Due to the many types of technique errors that can rapidly become bad habits, it is essential a knowledgeable adult supervise and reinforce touch typing techniques.

Handwriting speeds are not an accurate indication in projecting a student's goals for speed in keyboarding. A more accurate goal can be set based upon a one-minute timing of the home row keys following initial instruction of those keys.

Students using a word processor while learning to keyboard require less time transferring keyboarding skills to a word processing environment.

Selection of effective keyboarding tutorial programs requires an assessment of the techniques used in developing keyboarding skills and an evaluation of the philosophy underlying the order of presentation of keys. Programs should be previewed first with students to understand how the program might adapt to the classroom environment.

Keyboarding cannot be a goal in itself; once students have acquired touch typing skills, continuous and consistent reinforcement is essential.

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LOCAL AREA NETWORKS: A CLASSROOM SOLUTION

Georgina L. Seals

> "'Local Area Network' - connected computers in the same building. 'Network' - a continuing connection between two or more computers that facilitates sharing of files and resources." (Derfler, 1986, p.122.)

Until recently "networking" and "LAN" (local area network) were almost dirty words in education. Because of past experiences with networking, horror stories about network failures, technical problems requiring many hours or technical assistance, expensive equipment, and lack of available software, many teachers refused to consider a network system. Add to all those woes the technical background needed to administer a network, and it is no wonder educators shied away from considering a network system for their classroom.

All that has changed.

THE FUTURE IS NOW!

Our students are very much a part of the computer age and are going into a world of networking. We are living in a world of networking. Every time we watch television, use the telephone, buy a plane ticket, or get our VISA checked by a store, we are using a network of some sort. Businesses have been using networks for a long time--now it's our turn. Businesses use networks because they work, they are profitable, and they are efficient. Can we do less?

The students we are teaching today will be entering a world where more than one-half of them will be using a computer and where more than two-thirds of the nation's workers now collect, process, or store data. Many of these workers are using a network of some sort. Our students need to have hands-on experience with a tool most of them will be using--that means a computer and, if possible, a network system.

ADVANTAGES OF A NETWORK

A network:

1. Permits sharing of resources.
2. Alleviates problems with floppy disk handling.
3. Is flexible.
4. Gives immediate feedback.
5. Offers more efficient use of student and teacher time. (More on-task time for students.)
6. Provides for individualized instruction if desired.
7. Allows for prescriptive and diagnostic teaching.
8. Allows for increased productivity.
9. Provides for security of software and data.
10. May provide the teacher with a classroom management system.
11. Is an efficient use of taxpayer money.

PARTS OF A LAN

The local area network consists of several different parts: A server with a hard disk drive, workstations, network software, media, and network interface.

The server stores programs, provides communications, and allows for printing from the individual work stations.

Workstations may be personal computers that can also be used as standalone units, or can be designed specifically for the network, without extras that allow them to be used as standalone. For some applications, this is a more economical way to set up the network.

Network software makes the system work. It allows communication or movement of data between the server and the workstations. One of the features can be electronic mail.

Network Media is another word for the connection between the server and the workstations. In our school, coaxial cable is used.

Network interface connects the workstation to the media. Our system is configured with a network board in each PC. (Derfler, 1986, p. 123.)

The system at Illinois Valley High School consists of an IBM AT with a 30-MB hard disk, two parallel printers, 25 IBM PCs, Novelle Advanced Netware, PC Network, and a special software program called "PC Class." "PC Class" wraps around the Novell network, and allows a nontechnical person to administer the system.

HOW THE SYSTEM WORKS

Using "PC Class," software programs and users are installed on the hard disk. From this data base, classes are set up and the particular software for each class is designated into that class. As students sign up for the class, their names are transferred from the data base onto the class list.

This system allows for very selective and restrictive use of software and programs. The teacher allows only that software in each class that he or she wishes the students to use. Students to not have access to other software or classes. The system security also prevents copying programs from the hard disk by students.

Each student logs in when he or she enters the room. The class is selected, and then the program to be used for that particular day. At the end of class, the student logs out. If the teacher desires, a record of each login and logout is kept.

SOFTWARE

Since our network lab is specifically for the business education classes, all of our programs are for business education. In the year and a half since we purchased the network, the availability of software for networks has increased dramatically in all teaching areas. As a matter of fact, business education seems to have less software available than other subject areas.

A word of warning; however, make sure that the software can be networked before purchasing. In another year or so, I don't believe we will have to question whether or not a package will network. The vendors are responding rapidly to the increase in the networks. They are also becoming more flexible about site and network licensing.

SUMMARY

The advantages of the network system are obvious. We have delayed jumping into the network pond for some valid and some invalid reasons. It was "sink or swim," and most of us were sinking! There were many problems in the past, but most of them have been resolved. There are still some glitches, but overall, the network system works! It is time to overcome our fears and prejudices. It is time now to move forward and to teach the industry standard.

Network demonstration follows.

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Suggestions for further reading: Same as references and

PC Magazine, February 1985

PC Magazine, December 1986

LAN Times, August/September 1986

SCHOOL APPLICATIONS OF DESKTOP PUBLISHING

Milt Stanley

The term "Desktop Publishing", attributed to Aldus Corporation president Paul Brainerd, is one of the year's most overworked cliches. Others have tried, without success, to introduce alternative phrases like "Personal Publishing" or even "Computer-Assisted Publishing," all referring to the idea of personal computers providing sophisticated publishing tools for individuals. Like so many other developments in personal computing, newswriters label it a "revolution."

Desktop publishing may not be revolutionary, but most certainly it is an important step in the development of microcomputer applications. It has already changed the way in which many companies produce and distribute their in-house publications. The process, quicker and cheaper for many printing applications, is an attractive alternative to traditional publishing methods.

For the past year, we have experimented with desktop publishing at Kaslo Elementary-Secondary School on two levels: instructional and administrative applications. Having secured a grant from the Provincial Government's "Funds for Excellence in Education" program, we set up a twelve-station computer lab, with two Macintosh Plus computers, ten 512/800K enhanced Macs, two 20 MB hard drives, a LaserWriter Plus printer, and an ImageWriter II printer. The stations are networked with Appletalk, using MacServe as file servers for each of the hard drives. All nodes have spooled access to either printer.

The lab was set up to meet a wide range of instructional applications, including the traditional computer literacy courses, business education applications, and computer science courses. However, the system was also purchased for its desktop publishing capabilities. The lab presently serves both elementary and secondary students, with grades five through twelve logging the most time. Business education applications, computer literacy and computer science applications constitute the greatest use in the secondary school.

For the first two months after the lab was operational, formal training centered around the networking protocols and specific applications within regular courses, such as word processing or computer programming. However, enthusiasts were quick to discover the graphic capabilities of the machines, and output to the LaserWriter jumped. During "open lab hours", student and staff users set their own assignments, the majority of which fell into the "publications" category, from locker posters to display headlines for classroom tackboards.

At first, learning to use the system for publishing purposes was informal. In a process fairly typical of a computer lab environment, learning involved jumping in and proceding until an impasse was reached, then asking a question aloud to the room in general. Invariably someone had encountered the same problem and discovered the solution earlier, perhaps as little as five minutes before. And so on until the next problem. Soon the gurus became identifiable. They were always there, and had the answers most often.

I watched with interest the gradual development of an awareness of graphic design principles in all computer lab users. Students and staff began to criticize the appearance of their efforts. An appreciation for "what works and what doesn't" began to emerge, evidenced by comments like: "This poster uses too many different typestyles—it looks too busy!", or, "I thought the shadow font would really work well here, but it looks awful!" At this point I began actively promoting the use of the lab for desktop publishing applications.

I developed an enrichment unit for Computer Studies 11 (a general computer literacy course) that introduces students to publishing using computers. These materials, together with "PageMaker Classroom" by Aldus, give students experience with such desktop publishing applications as business reports and letterheads, posters, newsletters and technical manuals. The unit stresses the application of design decisions in layout and typography in the production of these publication examples.

Whether they realize it or not, computer users are often faced with design decisions, even while using a word processor. Knowledge of a few surprisingly simple concepts can change the printed page from a disorganized, unattractive, confusing mess to a crisp, clean and readable message. Many design concepts seem like common sense. Most of us need only to be reminded of them to begin producing a better publication.

For example, the business education student is now faced with a bewildering array of choices in the presentation of even the simple business report. Word processors, unlike typewriters, offer different typestyles, font sizes, and special characters. In providing emphasis, typewriters usually offer two choices: underlined text or, less often, a different colour. For the same function, many word processors now offer boldface, italics, or bold italics. Given these choices, underlining for emphasis is the least appropriate method. Another example: using the appropriate open quotes and close quotes (“”) instead of inch marks (""). With desktop publishing tools, a student preparing a business report can take advantage of options usually only available to typesetters.

Computers now play a greater role in meeting the publishing needs of businesses. Eventually, this will impact on the business education curriculum in schools, which will include basic design

principles in the production of presentation graphics and printed publications.

Another instructional application example is an assignment by one of the Computer Studies 11 student groups. They decided to publish a children's story book, and commissioned the grade three class to write it. With the cooperation of their teacher, the class wrote a poignant story about a wild rabbit that gets into a spot of trouble. The rabbit is rescued and nursed back to health by a child, who then must release his pet to its natural habitat. Story illustrations, provided by an art teacher, were digitized using ThunderScan, and placed in the publication using PageMaker software. The resulting book was printed on the school's photocopier.

The book is quite professional in appearance, including copyright information, a foreword by the school Principal, a dedication page, biography of the authors, and acknowledgements. The project required the collaboration of elementary and secondary students, each group bringing their special skills to focus in the publication. Although the idea of publishing children's writings is not new, the high quality of this publication greatly enhanced the feeling of accomplishment of both classes. Further, the book's publication heightened the sense of value the young authors hold for their written work. It occupies an honoured place in the classroom library. I expect to see many publication projects of this kind in schools that have access to desktop publishing tools.

Many students have begun using the lab to produce term papers and other assignments. Teachers have reported that students using the computer and LaserWriter to "publish" their term papers have taken more care in its final appearance, with increased attention to spelling and punctuation. This observation agrees with the experience of other schools using computers for writing instruction.

Finally, the most obvious application of desktop publishing has not been ignored by our school. Posters, dance tickets, office forms, test papers, student worksheets and handouts have suddenly taken on a professional appearance as more teachers (and the school secretary) discover the capabilities of the system.

It seems inevitable that desktop publishing will join the list of computer applications in schools, both in instruction and administration. After all, teachers and administrators have been in the publishing business for a long time. The business world is recognizing the importance of these tools to their publishing needs. So should we. Administrative applications may follow the example provided by business offices, but it will be up to teachers to discover and develop instructional applications.

ADDING MACRO CAPABILITIES TO APPLEWORKS

Neal Strudler

While AppleWorks has gained much popularity for its relative power and ease-of-use, experienced AppleWorks users have turned to "add-on" products to extend the program's capabilities. The models for such commercial programs often "trickle down" from productivity software designed for the MS-DOS-dominated corporate world. Macro capabilities offer a clear example of this trend. Developers of applications software, such as Lotus 1-2-3, incorporated macros into their programs and subsequently set new standards for user productivity. During the past year, several programs have been created to add such capabilities to AppleWorks. In this paper I will explore this trend and describe how macro programs can enhance the power of AppleWorks.

Why Use Macros?

Macros are "mini" computer programs that allow users to reduce any series of keystrokes in AppleWorks to a single-key AppleWorks command. When the user invokes that command, all of the keystrokes that make up the macro are carried out. For example, as I began writing, I defined a simple macro that types out "AppleWorks," a name that I will frequently use in this paper. I defined the macro using <Solid-Apple> and <N>, and I can now type that key combination to get "AppleWorks" to appear in my text. Of course, user-defined macros can be considerably more sophisticated and powerful.

Macro capabilities appear to be an especially welcome addition for experienced AppleWorks users. While beginning or infrequent users benefit greatly from commands that explain options and prompt the user for responses, experienced users often may prefer to streamline the process. For example, in the standard version of AppleWorks, if I want to add a file from my data disk onto the desktop, I need to press: <Escape>, <Return> (to add files to the desktop), and <Return> (to confirm the location of the data disk). Then I can choose the desired file from the listing of files that are available. In using a macro program, I can simply press one combination of keys, such as <Solid-Apple/A>, to call up a listing of my files on disk.

Macros, such as the one illustrated above, address a major shortcoming of the AppleWorks program. Good software should offer users the flexibility to control the amount of screen prompting involved in certain commands. While beginning users should be able to obtain user-friendly prompts and cautions, experienced users should be able to "peel" through the layers of the program for greater efficiency and speed. AppleWorks, however, lacks such flexibility. Experienced users must contend with the tedium of prompts and cautions designed for beginning users (e.g., "Are you sure you really want to do this?"). Macro capabilities allow users to eliminate unwanted options from the AppleWorks command structure.

In addition to offering users the flexibility to design their own macros, programs such as SuperMacroworks, published by Beagle Bros., provide an array of predefined macros. Such macros offer keystroke-saving features that Rupert Lissner failed to include when he designed AppleWorks. For example, when I typed the above heading, ("Why Macros?") I pressed <Solid Apple/C> to center the text. This macro, built into the program, replaced a five-keystroke sequence. After I typed the title, I used another predefined macro, invoked by <Solid Apple/L>, to left justify the paragraph after the heading. This macro also replaced a five-keystroke sequence. Subsequently, I pressed <Solid-Apple/P> to print a draft of my text--no questions asked. This macro replaced a four-keystroke sequence.

Are Macros for Everybody?

Macros clearly are not for everybody. Infrequent or beginning users do not need to be burdened with learning more commands. The addition of macros offers a tradeoff for the user. While they add power and flexibility, they also provide "one more thing" for users to deal with. Most beginning and infrequent users prefer ease-of-use to saving keystrokes. The unaltered form of AppleWorks was designed to meet the needs of such users.

In a sense, macros make AppleWorks more like programs such as the popular word processor, Wordstar. This program derives its power from a long list of single-keystroke commands that perform a variety of functions. Wordstar, however, is considered by many users to be difficult to learn. In contrast, the AppleWorks word processor is considered to be "friendly" to new users.

Some Macro Concepts

While macro programs for AppleWorks vary in their structure and capabilities, they are all based on similar concepts. It is my intention to discuss a few of these concepts, not to compare and contrast specific features of each program. For a more detailed review of three popular macro programs (SuperMacroworks, AutoWorks, and KeyPlayer), see "Macro Mania," by C. Van Buren, in A+ Magazine, April 1987, pp. 83-88.

Macro programs allow users to construct macros in two ways. One way is to "record" the macro by: (1) turning on the macro recorder, (2) selecting a key (to be used in conjunction with the Solid-Apple key, (3) pressing the keystrokes to be carried out, and (4) turning off the macro recorder. Then, once defined, the series of keystrokes can be invoked by pressing the designated key.

The other way to create a macro file is by using a special macro language that consists of keyboard "tokens." Tokens are used to represent special keystrokes. For example, <esc> may represent pressing the "escape" key and <rtn> may represent pressing the "return" key. Tokens are entered using the AppleWorks word processor module. This method of creating macros requires correct syntax similar to any

programing language. For this reason, the auto-record approach is far easier to implement than the "token" method.

Whether macros are recorded or entered through the keyboard using tokens, they can be permanently saved for future use. All macro programs include a means for "patching" or merging the macro software directly onto the AppleWorks disk. To add newly created macros to the AppleWorks program, the macros must first be compiled. Compilation is the process of converting the recorded or written macros into machine language before the program is executed. This process is similar to the one involved in executing a program in a compiled language such as Pascal. Macro programs come equipped with a compiler to perform this operation. Then, the updated macro file can be "re-patched" onto AppleWorks.

While many common macros may replace a few keystrokes, more sophisticated macros can consist of hundreds of keystrokes. Further, macro programs can employ many features found in programming languages. Macros can be embedded into other macros, much as programming procedures can be invoked from other procedures. Also, macro programs allow for users to incorporate "if/then/else" logical operators into their macros. Thus, macro creation is open-ended, much like programming in high-level computer languages. While recording a macro is as straightforward as pressing keys on the keyboard, programming with tokens and logical operators allows greater latitude for users to become "AppleWorks hackers."

User-Created Macros: Some Examples

New macro users will probably find that the pre-programmed macros included on the macro software streamline most of the "bulky" AppleWorks commands. Eventually, however, you will probably want to create new macros to address your specific needs. The first macro that I created enabled me to remove any file from the desktop in one keystroke--no questions asked. In standard AppleWorks, this requires an eight keystroke sequence that I find cumbersome. If the AppleWorks program detects any changes in a file since it was saved last, it reminds the user that "you made changes to this file." Unfortunately, when you save a file and then print it, AppleWorks recognizes the pagebreaks that it inserts as changes in the file. Therefore, it cautions that changes were made, gives the option to "throw out the changes," and asks, "Do you really want to do this?" The macro that I created circumvents this process, but also circumvents the safeguards built into the program. If I invoke this particular macro before saving the file, the changes would be lost. I therefore would not recommend this macro to new users. With the increased speed also comes a greater risk of error. I'm comfortable with taking this risk, however, and use this macro often.

I created another series of macros to expedite formatting my dissertation. When writing the text, I used a macro to indent frequent blocks of direct quotations and change from single spacing to double spacing. Following, I would use a second macro to return to the standard margin setting and double spacing. Once the macros were created and working properly, I found that invoking them both simplified

my tasks and reduced the "human error" that results from frequent typing of repetitive commands.

After completing the document, I found that the indented blocks were all one-tenth of an inch off the Graduate School's specified format requirements. To remedy this, I created a new macro that searched for the print option "left margin" and alternately ignored the first occurrence (the unindented text was formatted correctly) and changed the value of the second occurrence (i.e., deleted LM=2.0 and inserted LM=1.9). This macro allowed me to adjust the numerous indented blocks in the 240-page document in a fraction of the time that it would have ordinarily taken.

Summary

AppleWorks is popular for being a user-friendly integrated program, but lacks the flexibility to modify existing commands and create new commands. Macro programs add these capabilities to AppleWorks. While new or infrequent users will probably not benefit from such features, experienced AppleWorks users may benefit greatly. Unlike other "add-on" software designed to enhance AppleWorks, macro capabilities provide the tools to substantially increase user productivity. Overall, macro programs offer the flexibility to ensure that AppleWorks' capabilities will continue to grow with its expanding base of experienced users.

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Product Information

Super MacroWorks
Beagle Bros.
3990 Old Town Avenue
San Diego, CA 92110
(619) 296-6400
List Price: 49.95

AutoWorks
The Software Touch
9625 Black Mountain Road #204
San Diego, CA 92126
(619) 549-3091
List Price: 49.95

KeyPlayer
Pinpoint
5901 Christie Avenue #501
Emeryville, CA 94608
(415) 654-3050
List Price: 49.00

UNDERSTANDING SIMULATIONS

John L. Tenny

Simulations Are....

Simulations, as dynamic models of reality, can be exciting, fun, informative, and challenging. They are also frequently a complex tool--complex in both the selection and the use. There are many computer programs available to the classroom teacher which are labeled as simulations. However,a large number of these are not simulations at all, but commonly a tutorial or drill-and-practice program with reality-like window dressing. To be able to discern between these, and to be able to select and use simulations in an appropriate educational manner, it is necessary to have a broad understanding of the variance within the area of simulations.

Who Gets To Play?

There are a number of ways to view simulations. One way is the manner in which they are enacted, or played. A simulation can be played by humans, without the use of any form of machines. A child playing store is one example of this type; the common high school home economics activity of two students role playing being married and experiencing vicariously the act of setting up housekeeping is another.

Another way in which simulations can be experienced is a combination of man and machine, where each play a necessary role in the simulation. Most of the educational microcomputer based simulations are of this type. The human's typical role is to make decisions based on the information given and the goal of the simulation, and the machine's role is to serve as the outside world not under the normal control of the player. The machine provides the structured generation of natural events or the less than random outcomes of a player's decision. The machine is not necessarily an opponent, although that is possible and common. It can simply serve as the producer of outcomes based upon human interaction.

A third experience with simulations is one without humans as decision makers, involving the machine alone. Of course, humans need to set up the machine, input information, and be ready to receive and record the results; but the human is not part of the process of working toward the goal. Examples of this type of simulation are those that allow humans to predict the outcomes of cause and effect related natural events extended into the future--the prediction of weather or earthquakes based on past data, or the optimal design of sailboat hulls or space craft reentry vehicles.

What Kind Of Time Will It Take?

The use and/or representation of time in simulations is another way of thinking about them. Some simulations, in whatever combination of man and machine, are run in continuous time. Role playing experiences dealing with values in a family situation, or simulation of the wear of a mechanical joint in industrial operation are usually meant to be run from beginning to end without radically adding new input into the simulation.

The counter to continuous time simulations are the stop-time simulations. These are designed to run for a cycle of various dimensions, the results analyzed, new inputs made, and another cycle run. The advantage of being able to "stop time" and think about the events is a powerful tool in analyzation.

Time has some other categories as applied to simulations also. A simulation can be run in real time, an extension to continuous time wherein the events take the same amount of time as they would had the event not been part of a simulation. The two alternatives to real time are expanded time and compressed time. In expanded time events take longer than in real life, such as simulating the unfolding of a flower for observation purposes. In compressed time the events are shortened to varying degrees to take less time than real life, such as simulating the next twelve month cycle of the stock market in a computer program allowing input of changing economic factors.

Uses Of Simulations

With these quasi-physical characteristics in mind, there are still other ways to categorize simulations. The simplest division might be the difference between using a simulation to learn (or teach) something as opposed to playing a simulation for the pure enjoyment or pleasure. Many popular board games, such as Monopoly, are simulations, and while something is always learned from interaction with others, the primary benefit of playing Monopoly is pleasure. One does not gain important principles to serve as a basis for business decisions from the experience.

A simulation as a learning tool can again be viewed from numerous perspectives, the primary division between whether the learner (student or scientist) is setting the learning goals or a teacher has chosen the simulation to reach a goal outside the intent of the learner. Of course, the best situation is a combination of the two.

When the learner is the goal setter, a simulation is serving as a research site for the purpose of theory testing, or as a prediction device used to extend outcomes past the limits of confirmed reality.

The process of using a simulation as a research site includes the investigation of reality for the purpose of devising a theory (abstraction), making deductions and predictions based on that theory, and then comparing known reality with the

outcomes of the simulation. If the abstraction of reality and the deductions logical and complete, the results of the simulation will match reality. Where there are discrepancies, either the abstraction or the deductions need to be rethought. There are many examples of extremely complex simulations in scientific research, where successful development of the simulation leads to the second use, that of a prediction device.

Once the development and testing of a theory have reached a satisfactory level, they may be successfully used as a prediction device. An example of the massive power of these models may be seen in regional weather forecasting which requires hour-by-hour computation of 40,000 pieces of data. A combination prediction model of the source and effects of acid rain uses all of the regional weather data (40,000 pieces of data per hour) in combination with a chemical model that incorporates equations representing chemical reactions along with documented emissions of pollutants. These specific emissions are fed into the simulation on an hourly basis, and the combination results in an accurate prediction of the cycle of pollution as well as the effects of plans to effect change in this disastrous area.

While the power needed to operate such large simulations is not available to the classroom teacher, students can use simulations as research and predictive tools with basic techniques and thought processes being greatly enhanced.

There is yet another, and final category of simulations--the simulation as a teaching tool. The strength of the simulation in the classroom is not in its ability to implant lists of facts, but as an arena in which to interact with information, make decisions, and experience outcomes. The task of the teacher, if the simulation experience is to rise above the Monopoly level, is one of careful thought and in-depth planning, of being a guide through both the complexity of the simulation and the intricacies of the concepts experienced.

The first step in that planning is deciding on the educational goal. Goals worth the time and effort of using a simulation usually fall into one of three areas: attitudinal change, application of knowledge, or the acquisition and comprehension of new knowledge.

Once the goal is selected, the particular type of simulation to be used must be selected. Among the choices are structured experiences, role playing, in-basket and incident simulations, as well as the types of simulations referred to earlier for scientific investigation and prediction.

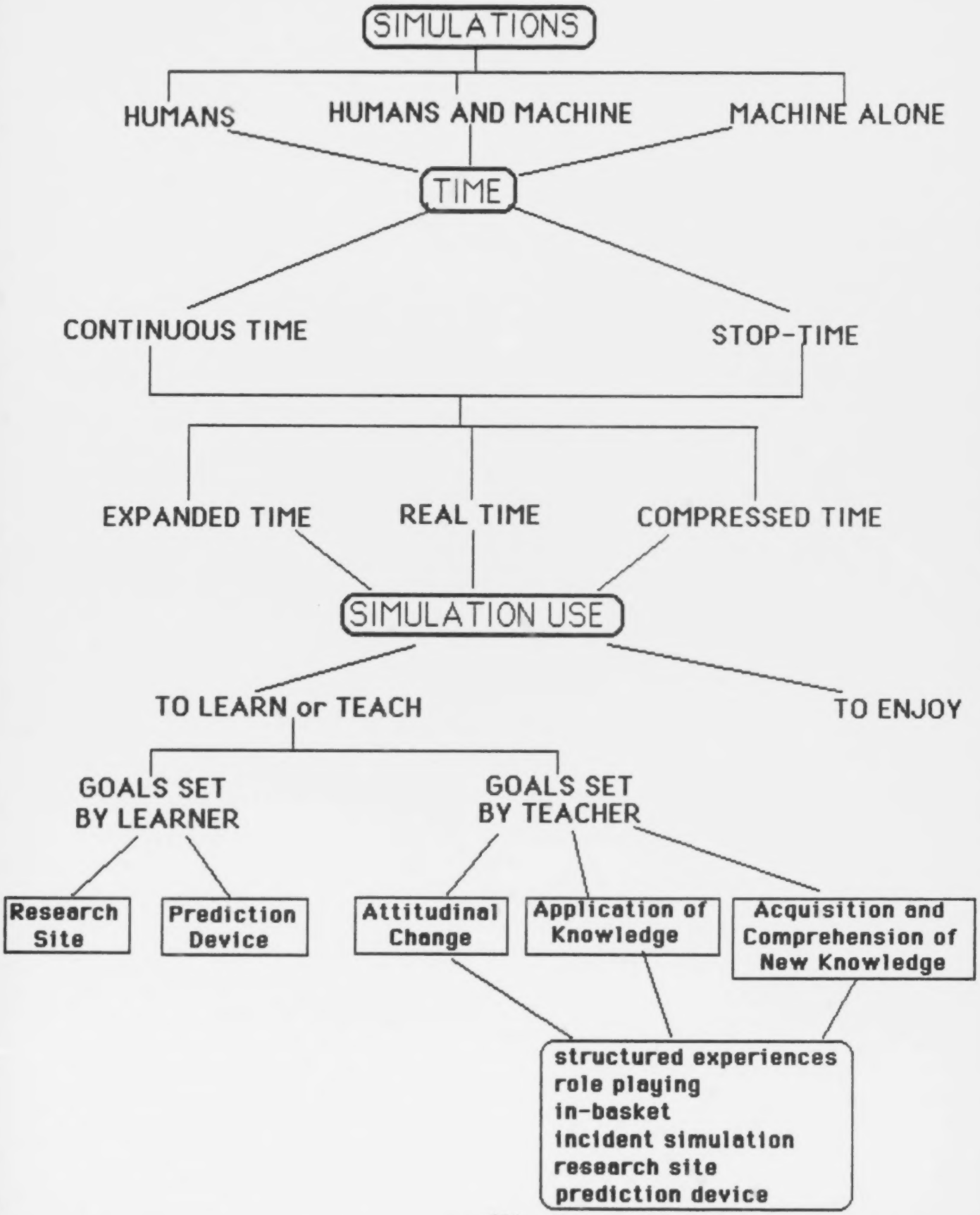
Simulations may be designed and produced, either on or off the computer, to meet the teacher's goals. As with most educational materials, even the best of commercially available simulations need some adaptation to be of individual interest and use.

The details of the planning and use of a simulation must include four points: (a) identification and explanation of the purpose/goal of the simulation, (b) pre-teaching of the rules, procedures, and prerequisite information, (c) sufficient time and materials to play the simulation, and most important (d) time devoted to "debriefing", the bringing to the surface of the

subconscious relationships between the various facets of the simulation experienced during the play. As opposed to rote learning of surface level bits of information, the depth of learning often experienced during a simulation is greatly strengthened through the "debriefing" process.

Be Careful of...

There are a number of things to be careful of in the use of simulations. Efficient use requires (a) that the simulation represent reality--fantasy worlds with made-up laws of nature, creatures with magical powers, and out-of-world consequences may be intriguing, but are not simulations and seldom lead to useful skills in "our" world; (b) that the relationships, usually on a mathematical basis, between facets of the program be represented reasonably accurate to the real world. Many programs use the random number generator too much, resulting in an uncontrolled variety that no longer represents reality. Storms on a prairie or the direction and rate of interest rate changes are not random in the real world, but are often represented as such in simulations; and (c) that the teacher remember that the benefit of simulation in the classroom is in the experience, not in the outcome. Students must be given room to make and see the results of incorrect decisions, develop and correct faulty strategies, and to interact with the others involved in the simulation. The benefits are often enthusiasm, integration of content and concepts, and transfer of "school concepts" to the real world.


SIMULATIONS
HUMANS
HUMANS AND MACHINE
MACHINE ALONE
TIME
CONTINUOUS TIME
STOP-TIME
EXPANDED TIME
REAL TIME
COMPRESSED TIME
SIMULATION USE
TO LEARN or TEACH
TO ENJOY
GOALS SET BY LEARNER
GOALS SET BY TEACHER
Research Site
Prediction Device
Attitudinal Change
Application of Knowledge
Acquisition and Comprehension of New Knowledge
structured experiences
role playing
in-basket
incident simulation
research site
prediction device

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ROBOTS IN THE ELEMENTARY CURRICULUM

Elizabeth Anne Viau, Ph.D.

As we look ahead into the mists of the future, hazy outlines of a technological world tease us. We catch glimpses of spired cities, shimmering in an electronic nerve net, pulsing to the measured cadence of machines; we see vehicles flashing past, finding their own roadways with hidden eyes. For a moment we are dazzled, caught up in the sheen and movement of the vision; then, inevitably, our eyes begin to search for the citizens themselves. Here the mists swirl, the image is enigmatic: the form moves in and out of focus, changing proportions like a carnival mirror reflection. Do we see ourselves, or, perhaps, our children? Are these human beings, in soft, shimmering cloth? Are these cyborgs, men and machines blended, creatures enjoying undreamed of strength, and even immortality? Or is it the robot that arrests our gaze, man's technological self-portrait, idealized, yet lacking, as a portrait must, those qualities that the medium of its creation cannot express?

Computers, Robots, and the Elementary Curriculum

Turkle (1984) has described the computer as a mirror for our minds, a "second self". The fascination that the computer has for us is very real; its power to hold our attention is demonstrated repeatedly, with young children as well as adults. The capabilities of the computer are compatible with many aspects of the curriculum: the computer stores and manipulates data and numbers, it serves as a tool, it structures microworlds, uncovers patterns, and invites problem-solving. The computer does some of the work that the human mind can do. But the computer is not, in any sense, a mind--it is only a tool. The work of education is to empower human minds: to lead out and strengthen the creative imagination, the synthesising vision, the restless curiosity. "The mind is a fire to be kindled, not a vessel to be filled (Plutarch)."

The facts that we teach our children are raw material, bricks for the construction of their own understanding of the world: these facts pile up, threatening to bury us, and leaving scant time for the practice of the architectural skills of the intellect. As computers are absorbed into the structure of our society, our educational systems, at present struggling with an explosive multiplication of factual knowledge, will shift some curricular content on to computers: calculators will reduce memorization in mathematics,

electronic data searching will replace tedious hours in the library, spelling checkers will make spelling a footnote, and visual media will revolutionize the presentation of social studies. As we struggle towards the schools that are to come, classroom teachers can begin to explore new possibilities, providing children with opportunities for the creative synthesis of knowledge and imagination.

Where Robots Came From--Machines and Dreams

One possible vehicle for this synthesis is the natural fascination that humans feel for the robot. The robot's appeal has deep historic roots--the desire to create man-made life existed before written history. Tales about the transformation of an inanimate object into a living being come to us through the words of Homer, and through the Greek myth of Pygmalian. These myths celebrate the skill of the artizan, but life comes from divine or magical power; the thread of the tale goes on through the Golem of Prague, in 1580, Frankinstein, Karel Capek's robots (in his play, R.U.R.(1923)), and Isaac Asimov's (1977) robots with their "positronic brains". The robot has roots in literature; it carries powerful metaphoric messages about man's relationship to the environment, and about man himself.

The lineage of the robot can be traced through a second line of thought. The engineers of classical times used compressed air, steam, and water power, to provide energy for the movement of their machines. Their skill was applied to the creation of toys for adults, a tradition that was revived after the end of the Dark Ages. Eventually human-appearing figures, such as the Scribe (1770) and the Lady Musician(1773) used programs of mechanical cogs to govern their movements (Reichardt:1978). After the industrial revolution, mechanical and wind-up toys could be produced inexpensively, and these toys finally delighted children as well as princes. Practical applications of discoveries produced the Iron Horse, the Horseless Carriage, and even the airplane. The development of artificial muscle-power, and of engines that could utilize high energy fuels, produced mechanical replacements for laboring domestic animals, and reduced the need for human strength. The machines, however, were insensate, and less intelligent than the animals that they replaced. Machine operation required human guidance, monitoring, and correction.

The mechanical forerunners of the robots to come were built by men: they attained mobility from the engineer, not by supernatural intervention. Man-made

robots have taken over the robot fiction of today, appearing in science fiction magazines, on television and in movies: the most recent and spectacular examples have included C3PO in the Star Wars series. C3PO, while obviously manufactured, is human in appearance and in personality: his little companion, R2D2, is "child-like" in his size and incomprehensible babble, yet displays such admirable characteristics as courage, loyalty, and independence. Both robots are repaired when damaged, linking them to the principle of interchangeable components that is the mark of the industrial age. Their personalities, speech capabilities, and power to perceive and interpret the the environment, are sheer fantasy, however: the present state of robotics is far different from the dream.

Intelligence and self-direction in machines, even on a limited scale, require information storage and communication between the the mechanical and guiding components of the device. In living organisms these functions are carried out by a nervous system: machines have had to await the development of electronics. Electronic inventions, most recently transistors, integrated circuits, and increasingly complex circuitry on silicon chips, have offered us components that may be combined into an analog of a living nervous system. Electronic components can be assembled and programmed to make choices, to store information, to receive input in various forms, and to send signals to electrical motors. Although electronic "nervous systems" are primitive in comparison to biological ones, impressive progress has been made in only a few years. Robot enthusiasts have cause to hope that intelligent machines, capable of appropriate interaction with the environment, may be built in the future.

Real Robots

Present day robots already exist, working in factories, assembling components, lifting pallets of materials, painting automobiles, and welding. These robots, however, do not resemble fictional robots, for working robots are often merely arms, or a combination of arms with other components to create a work station. Working robots have limited senses, and are often fixed in place. They are interesting in their own right, but are not the robots that stir the imagination.

Exploratory robots, like the ones that photographed the Titanic or landed on Mars, may have mobility, and more "senses". However, though the robot moves its TV-camera "eye", it is a human who must interpret the picture; the commands that the robot follows are based on decisions made by human beings.

Robotic Toys

Toy robots are the robots best suited to the elementary school. They are small, often inexpensive, and they illustrate solutions to some of the problems that the builders of larger robots have had to solve. A listing of toy robots that this writer has used follows.

Radio Shack Robots

The Radio Shack carries very inexpensive robots, although the robots they have on hand vary from time to time, and may be suddenly discontinued. During sales the robots are usually 50% off. Among those recently available are:

Armatron ($30.00) is not controlled by a program from within, as it is operated with levers. It cannot store a series of commands. However, it is an excellent example of a robot arm and gripper. Although plastic cones come with it, they are too slippery for the arm to grasp reliably. Cut a small, soft sponge into blocks and put the arm to work!

The Robotic Banker ($13.00) is a fine little "pick and place" robot, similar to industrial ones that transfer objects from one place to another. This one is self-starting when a penny is inserted into the slot. It picks the penny up and drops it into a bank receptacle. Although this robot does not fascinate adults for long, kindergarten children will play with it for extended periods of time, finding different ways to get it to go into its invariant routine.

The Space Robot ($8.00) is interesting in that it runs in pre-determined patterns. The patterns are set by interchangeable cams which are, in effect, visible programs. Children are able to watch the cams in action.

Tomy Robots

Tomy has decided to stop producing their line of toy robots, but some of these robots are still in the stores. Toys-R-Us has carried them. Watch for the Dustbot, which will turn if it runs into an obstacle or is in danger of falling off a table. Crackbot responds to sound, and Verbot can be programmed to respond to eight words of the owner's choice by going forward, back, turning or stopping. These robots are sturdy and appealing, with "faces" and lighted eyes.

Compurobots

Compurobot and Compurobot II are truly programmable, and can remember a sequence of up to 94 commands. Compurobot has a pad of twenty five buttons on its "head" which are marked by numbers (for how many seconds it should act) and small arrows which indicate the direction that the robot should move in. Compurobot II is directed by a separate, hand-held "teach pendant". It can do everything that the Compurobot can do, and, in addition, can play music and trace out its path with a crayon holder in its underside. Compurobot II can also be programmed on an Apple IIe computer (with a super-serial card) by means of a disk which comes with the robot. The robot receives instructions from the computer via a RS232 cable, stores the instructions, and can then be disconnected and directed to begin its task. Both robots are sturdy, and have many possibilities for doing arithmetic problems and running through mazes. The turns and distances that they run, however, vary somewhat with the surface that they are on, and also with the state of their batteries, which last a long time. The company that imported these robots has decided to stop carrying them, but still have quite a few Compurobot IIs left. There are rumors that Compurobot will be marketed by another company.

Movits

Movits come in kits. They are small, somewhat fragile, robots that respond to conditions in the environment. The kits can be put together in two or three hours: the directions are excellent, but the nuts and bolts are very, very small. No soldering is required. Once a movit has been assembled, the bolts tend to work their way off, from the vibrations of being in a car, for instance. (Assemblers should be sure to dab the nuts with super-glue or nail polish to help to keep them in place!) Movits range in price from about $24 to $85 and individual models may respond to sound, or obstacles. One movit, the Line Tracer will follow a dark line on the "floor"; the Navius can be programmed by shading in small squares in a paper disk which is placed in the robot; an infrared sensor then "reads" the dark and light blocks, using the information to direct its movements.

Axlon Robots

Axlon is a company that is expanding its line of robots. It's first offering, the Petster ($40.00) is a hemispherical robot that is covered with synthetic fur. Kindergarten children and adults love it. The Petster responds to sound in the environment, and seems almost

alive as it runs about on the floor. It will respond to pre-programmed sound patterns, or to ambient noise in the classroom, and sometimes responds with sounds of its own. This year Axlon has added the Pupster, Godzilla, a Spider, a Penguin, and Fluffy, all of which are similar to the Petster in their basic programming and attractive, furry exteriors. This writer found kindergarten girls more attracted to the Petster than boys--boys might prefer Godzilla or the Spider. Another dog toy, Sic'Em Sam has an infra-red sensor that will cause him to search for and play with his ball.

Two more sound-activated toys are the Hamster ($23.00) and the FunFish. Both toys can be placed in a clear plastic ball, which rolls forward as the toy moves. Small children will immediately drop to hands and knees to crawl after the moving ball, older ones might learn something about friction and the center of gravity as they watch the ball roll.

A final robotic toy from Axlon is the "Robopup. This toy robot looks like a metallic dog. It follows the basic Petster commands, but can do much more: it can bark, sing, tell time, wag its tail, and be programmed to memorize a series of actions and sounds. It has a 140 word vocabulary, and can detect, and respond to, obstacles. Try Toys-R-Us to see these robotic toys.

Robots in the Curriculum

Arithmetic seems like a natural area for the use of robotic toys, especially as several of these toys follow LOGO-like commands. Toy robots, such as the Compurobot, can be programmed to run along number lines or in mazes. There are many ways of representing computation, however, and some young children might find static objects, such as blocks, easier to visualize and remember than the dynamic movements of a robot. Traditional arithmetic questions require convergent thought, where only a single answer is correct. With toy robots, the children can develop mapping, measuring and estimating skills, by having the robot go to some specific point, or around or under some object.

Language Arts units planned around robots can teach a variety of skills. Stories about robots are available for all ages: listening, reading, and discussion can be practiced, and used as a prelude to creative writing. An endless number of story starters are possible--a robot could arrive from outer space, be delivered by UPS, or be built by a mysterious neighbor. Quotation marks can be reviewed as the student converses with the robot. If the student wants to direct the robot, he will need to give it sequential commands, thus

practicing another skill. Describing what a robot can do, and the structures it must have to do the tasks, requires another kind of relational thinking. Adventure stories using choices, with a Story Tree format, would encourage group planning skills and cooperation, as well as making interesting reading for the remainder of the class. An intelligent robot, being an imaginary creature, allows scope for open-ended discussion and writing without the risk of being wrong: because it is a mirror to man, it allows for a a great variety of formats and adventures. Robots encourage oral as well as written language expression, serving as a focus for group interaction as well as discussion. Individuals my serve as the robot's "voice" encouraging shy children to speak. Kindergarteners in free play settings engage in animated conversation with the Petster, and in dramatic play with the Armatron; groups tend to form around robotic toys, resulting in discussion and cooperative play.

Social Studies is another fertile area for the use of robots. Robotic toys can get a unit started: future studies rightly explore topics from the question of how robots will affect the unemployment rate to whether it is murder to turn off an intelligent machine. If robots were to have their own society, what laws would they have? How would they treat the world? Polluted water might not seem important to robots--but conservation of metals would. By speculating about how intelligent robots might organize their society, students could see more clearly how human societies are built on human needs. Contrasting knowledge transfer between people and robots is interesting. How inefficient education seems, compared to effortless modem-to-modem transfer! Yet each method has its advantages--and its price.

Art projects featuring robots can be integrated with Language Arts and Social Studies. Whether the project is a drawing of a robot, a collage, a three-dimensional styrofoam model, a puppet, or a clay sculpture, the children will be challenged to relate form to function. Dioramas, futuristic model cities, and murals, are projects suitable for small group work.

Science is a natural area for the introduction of robotic toys. Comparing natural systems to robotic ones can lead to an increased understanding and appreciation of living creatures. Such taken-for-granted functions as locomotion and vision take on a different aspect when seen as problems that must be solved. Ecological systems can be contrasted with mining and manufacturing to show the difference between renewable and limited resources. Even very simple experiments involving the center of gravity are fun when robots run up ramps.

Different structures, such as tracks and wheels, can be compared and contrasted. Young children enjoy turning the robots upside down and watching how turning off the motor to one wheel will cause the robot to turn. If the children are allowed to observe and to play with the robots, they will discover problems, build and test theories, and find solutions.

In the elementary grades, we lay a broad foundation of general knowledge; we give children the traditional tools of mastery of the three Rs. Although robotics, itself, is too complex and abstract for the elementary school, the robot, even the idea of the robot, can serve as a mirror for the study of man. In an age when technology seems so marvellous, so overwhelming, let us not loose sight of the miracle of man himself.

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USING ROBOTS TO TEACH SCIENCE

Elizabeth Anne Viau, Ph.D.

Robots are here. Perhaps we do not recognize them: film and literature have prepared us for an elegant C3PO or a clanking metallic monster. We do not think of the washing machine as robotic, or say "I'm programming" as we set the dials. We laugh at the toy Petster, enjoying its antics, not seeing it as a first tendril, reaching out from an ocean of inanimate unknowing toward a new kind of awareness. Hidden in the factories, robots are at work, spray painting, lifting, welding silently in the dark. Will our children have to compete with them for jobs? Will they work side by side with robots? Will robots serve them, or will they serve the robots? The way that they think about robots will help to determine the answers to these questions. What should we, as educators, be teaching them?

Ways of Studying Robots

There are several different ways of approaching the study of robots. One way is to learn about robots: their history and applications. A second approach could be a mathematical and programming one. The children could also study robot construction and design, or use the robot as a point of entry into other areas of interest.

History and Applications

The idea of giving life to the inanimate goes back into prehistoric times. The study of the journey from sacred tree to moving statue to clockwork toy to computer-controlled arm is a fascinating one, as is the story of the robot's growing sophistication in literature and film. Present day applications, working robots, exploratory robots, robots used to help the handicapped, toy robots, and experimental robots, are all interesting topics, and would make a good social studies unit. Projections of the impact of robots on human laborers would be a natural culmination.

Programming Robots

A second area for teaching about robots is working with robots themselves. In the primary grades, children can program robotic toys, such as the Compurobot, as part of their arithmetic lessons; in high school, able students could use computers to

program the movement of robotic arms in three dimensions. The special programming languages that are used with robots could be taught.

Building Robots

On the amateur level, robot design is a labor of love, combining creativity with hard work, experimentation and, in many cases, a good deal of frustration. The projects seem playful: W. Grey Walter built artificial tortoises (Reichardt, 1979) and Claude Shannon constructed an electro-mechanical mouse to run mazes at Bell Laboratories (Halacy,1985: Knight, 1983). High School students could learn how to design and build a very simple robotic toy in an electronic shop class, but most young would-be robot builders would probably be most successful if they started with a construction set.

Construction Sets are made of snap-together parts and have battery-powered electric motors that can be programmed by means of control panels. Playing with them can give children a better understanding of gears, motors, and power-trains. Capsela and LEGO TC Logo have developed materials for teachers.

Capsela ($20.00 - $69.00 Toys-R Us) is centered around transparent plastic spheres with six protruding cylindrical openings which allow for the snap-together connection of other spheres or elements. The builder can see motors running and gears turning in the spheres once he gets his creation moving. Kits also include gear wheels, caterpillar tracks, lights, and various connectors. The Number 2000 kit includes a programmable element which can control movement in all directions, and turn on individual electric motors, lights, and sound. Up to 94 commands can be stored and executed. The Capsela Scientific Kit ($110.00) includes 120 components, worksheets and an Illustrated Teacher's Manual with twenty-five lessons which can be adapted for children in the third through ninth grade. It appears that the machines the children would build are operated by remote control rather than with a programmable component: this could be ordered separately, however.

Robotix ($15.00 - $70.00 Toys-R-Us) also has a controller that can be a part of the child's creation. It includes parts that may be built into an interesting gripper.

LEGO TC Logo (Starter Pack $450.00) provides interesting additions to the traditional LEGO blocks. These additions include pulleys, small air-compressors,

motors and a variety of gears. The motors can be programmed from an Apple IIe or a manually operated, four-switch control box. A 102 page Teacher's Manual is available, which provides lessons on such subjects as gears, levers, friction, simple machines, pulleys, and problem solving. Activity cards are available.

FischerTechnik makes robotic kits. The first of these kits to become available has materials for the construction of ten robotic projects. It includes directions, and can be has connected to the Apple IIe, Commodore 64 and other computers. It is controlled from the computer console by programs written in basic. These kits do not appear to be suitable for young children--high school students would be more likely to have the concentration and coordination necessary for success.

Robots as a Gateway to Science

Another possible way to use the robot in schools is to use it as a gateway for entry into other areas. The imaginary aspects of the robot permit many playful, open-ended questions, and can give the children opportunities for theory-building, and the construction of logical structures. The robot can be used on a very concrete level, and can open new perspectives onto familiar problems. For example:

Energy cycles: If robots took over the earth, how would they be powered? This is an interesting question because robots are (potentially) immortal: they would have to worry about problems that we ignore. If they are going to be gasoline powered, for instance, what will they do when the oil runs out? Many of our present day activities are not economical in terms of energy--sometimes it costs more calories of energy to get fuel into a useable form than the same fuel will yield when used. Robots--who, after all, are computers embodied--will be able to figure that out! Of course, there is always coal, and the infinitely renewable wood--a lot of energy would be spent on harvesting these resources, however, and when they were burned, the robot would have to have some way of dissipating the heat. Would the robot have to have a big stove as a part of his body? Even little children can understand this problem!

Maybe we need a different approach. Hydro-electric power is clean and cool: small amounts of it, relative to our present day use, could be generated by flowing rivers, or by tides. Are we getting anywhere? We have cool, clean, non-polluting, endlessly renewable power--and how long an extention

cord would you like? If the robots want to stay in one place, there would be no problem; batteries are practical for short distance travel, even though they are heavy and bulky. Are there better ways to travel? The robots could try wind-power--but sails and propellors are clumsy additions. Perhaps photo-electric cells and solar power are the way to solve this problem. This solution has a familiar ring--plants, too, draw their energy from the only source that comes from outside the terrestrial system--the sun. They store up this energy in tubers and roots, leaves, stems, seeds and seed-pods. Are these organic power cells somewhat analogous to batteries?

Mobility becomes a question if we study the energy-storing strategies of plants. Why don't plants move? They can get everything they need right where they are. The animals are not so fortunate. They must wander the earth, driven by hunger. Is hunger the root of curiosity, perhaps even of intelligence? A computer or robot fed by a generator on a river bank might not have a reason to go somewhere else. What kind of a "mindset" could an observer expect in that machine?

Needs may be the thing to study now. What does the robot need to survive? Like an animal or a plant it must contend with the environment--water, dust, dew, and temperature changes. Animals and plants are, in a sense, sealed systems--holding the precious, chemically correct fluids in, keeping other fluids out. The robot needs to keep fluids and dust out, too--yet a sealed carapace is vulnerable to heat build-up. How do animals handle heat build-up? We are headed into physiology now, perspiration, blood circulation, the constriction and opening of capillaries. Perhaps we had better see how reptiles solve this problem!

Survival Senses are beginning to look important. The robot has to know when heat is building up: it has to know when its batteries are low. Although the robot has no natural enemies, it must still be aware of threats to its circuits--corrosion, small spider-webs, and possible leaks. It must also have some strategies for dealing with the emergencies. Should it call for help through the modem? After a few thousand years the wires may be down, or the satellite knocked out of orbit by a meteor. Should it shut down a part of itself to save the rest? This is a strategy that will ultimately result in the robot shutting off completely. Perhaps there is a need for community and specialization even in a robot-owned world! At this point the termite nest might make an interesting study--perhaps a big computer with all the information

is like the queen--with all necessary tasks done by expendable, peripheral units.

Recycling broken parts and finding new stores of metals would be important for roving robot units. In the natural world there are great wheels of circulation--the water cycle, going from cloud to rain to river to cloud; organic chemicals, going from soil to plant to animal to soil again. Chemical changes liberate energy, but the sunlight replaces that--carbon, nitrogen, and minerals stay in the system, moving in and out of living beings. Machines have no such cycles. Metals mined are mined forever: metal atoms lost to friction cannot be recaptured. If robot societies have laws, they may not be Asimov's Three Laws of Robotics! The law of the conservation of metals would be primary, because, given a finite stock of metals and a potentially infinitely long life span, running out of metals would mean terminal shutdown! How does all this relate to human societies, and human laws? Would we treat our planet differently if we thought of it as the only world we have? Are organic life forms compelled to live in harmony with nature to survive? Are robotic societies fundamentally out of synchronization with nature, and so, ultimately, doomed? How would robots treat our planet? Would they be concerned with the corrosive effects of acid rain? Would they care about soil erosion and blowing dust? Would radioactivity scar their chips as surely as it would scramble genetic material? Even a playful fantasy with robots can dredge up serious questions. We see our own faces reflected in the shiny trunk of our mechanical tin woodsman.

Alternate body styles are a possibility with robots. Present-day robots are designed to do one thing, or one class of things. Animals and plants, however, have to do many different things, and to survive every day long enough to reproduce themselves. A computer can be shut down without harm, except loss of ephemeral memory; a living system cannot. If, in our robot society, all the information is stored in a group of interconnected central computers, small, scurrying, less intelligent robots could see to the special needs of the colony. This gives students a wonderful opportunity to study body design, for in the robot, we can put the body together in any way that we wish. Is there a logic to the way organic life forms are arranged? Why not have eyes in the front of the shins, so the feet won't stumble? If the mouth were closer to the stomach, it might not have to share the larynx with the lungs, and people wouldn't choke on things they swallow. Do we need an extra pair of hands? Letting children playfully draw and model

possible robot forms will help them to understand the important relationship between form and function; it will allow them to see that there is a logic to design.

Anatomy is an important part of biology, and it can be cross-referenced with machines. The hinge joint, the ball and socket joint, and the flexibility of the spine all have their mechanical analogs: older children could experiment with puppets to see how joints aid mobility. Certainly the problem of maintaining structural rigidity, while allowing for swift and efficient movement, is worth study: the crab has a different solution from the fish--and each must pay a price. Does it make sense to have robots shaped like people? A little play with toy robots, such as the Compurobot, quickly shows the effect of the center of gravity on stability. Take a dowel and run it through opposite sides of an empty carton, once near the top, and again near the bottom of the box. Notice how each location balances. Does this show why the femurs are attached at the bottom of the pelvis, and not the top? Which placement is most economical in terms of the energy needed to maintain balance?

Extra senses can also be explored by re-designing the body. Present day robots can read precise temperatures, see in the infra-red spectrum, detect smoke particles (smoke alarms), have telescopic vision and extra-sensitive hearing. They can record conversations and, with an internal clock, always know what time it is. They can match voice prints, telling one person from another, and plug in to a modem. The Six Million Dollar Man was a fantasy about possessing extra powers--perhaps some of these might be useful to a robot.

Mechanical principles are utilized in biology: the bones as levers, the fine tolerances, the shock-absorbing power of cartilage, the lubrication in the joints. If organic life forms are studied as machines, their beauty and perfection is striking, yet they surpass machines in their ability to grow (always without sacrificing function) and to repair themselves. Reproduction, with its recombination of genetic material, is another miracle, for each living thing is unique, a prototype. This is an enormous difference between robots and organic life forms; robots will tend to be true to their model, perfect reproductions, while living creatures are true to their species, expressing and extending its attributes in unique ways.

For students who are electronically inclined, experimentation with photo-electric cells and buzzers might be fun. The Radio Shack sells a kit called the

Sensor Robot 20 ($15.00); it can be wired and rewired indefinitely without solder to complete circuits that activate sensors for light, sound, magnetism, and moisture. It has directions for twenty experiments, laid out so that anyone can be successful: although schematics and explanations are included, the student need not know anything about electronics to succeed. There are, of course, biological and electronic analogies: a reflex can be represented electronically, and comparison of nerve cell structure and electronic schematics show the richness of organic connectedness as compared with the present state of our electronic designs.

In closing, let us think of robotic education. How easy information transfer is! Connect the jack of the modem and the information just flows in, carefully checked to assure perfect transmission. How students, and teachers, sometimes envy this ease! Yet it is precisely because education is difficult that mankind progresses--the young catch the information imperfectly, and what is useless simply fades away. Puzzling over a garbled transmission, a Newton or an Einstein may arrange "reality" (as we conceive of it) in a new way, drawing us on toward an increase of knowledge. Because there is much that we cannot be certain of, tolerance becomes a necessary virtue: the study of history shows progress when the mind is free. If robots were to take over our world, "truth" would be available in identical form to all: dissonant circuits could be repaired--or disconnected.

The study of robots as gateways is really an exercise in comparisons, a way of looking at the marvels of the organic world as well as the marvels of our own technology. We see the individuality of creatures, each fitted to strive for survival; we see the standardization of our own inventions, their interchangeable parts demonstrating an underlying oneness of mechanical being. As our students grow into the twenty-first century, it is essential that they learn to respect and understand, not only our wonderful technological world, but the world of nature on which our survival rests.

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MAKING THE CONNECTION: SOFTWARE DEVELOPERS AND EDUCATORS

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The purpose of this paper is to provide general legal information which will be of benefit to educators who are interested in being involved with the creation of educational media. The topics that will be covered are: 1) The basics of copyright law; 2) Copyright law and the employer; and 3) Contractual relationships with developers and publishers.

The Basics of Copyright Law

Educational media is generally protected by copyright. Under the Constitution of the United States, Congress has the power to "promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries." U.S. Constitution, Article I, Section 8, Paragraph 8. Pursuant to this grant of power, Congress has enacted the copyright statutes.

Copyrightable Works

Copyright law protects original works of authorship that are fixed in a tangible form of expression. Copyrightable works include the following categories: 1) Literary works, including computer software; 2) Musical works, including the accompanying words; 3) Dramatic works, including any accompanying music; 4) Pantomimes and choreographic works; 5) Pictorial, graphic, and sculptural works; 6) Motion pictures and other audiovisual works; and 7) Sound recordings.

Copyright law does not protect the following: 1) Works that have not been fixed (i.e. improvisational); 2) Titles, names, short phrases, slogans, familiar designs, mere listings of ingredients or contents; 3) Ideas, procedures, methods, systems, processes, concepts, principles, discoveries, or devices, as distinguished from a description, explanation or illustration; and 4) Works consisting entirely of information that is common property and containing no original authorship (i.e. standard calendars).

The Copyright Rights

The Copyright Act gives the owner of a copyright the exclusive right to do and to authorize others to do the following: 1) To reproduce the copyrighted work in copies or phonorecords; 2) To prepare derivative works (modifications) based upon the copyrighted work; 3) To distribute copies or phonorecords of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease or lending; 4) To perform the work publicly, in the case of literary, musical, dramatic, and choreographic works, pantomimes, and motion pictures and other audiovisual works; and 5) To display the copyrighted work publicly, in the case of literary, musical, dramatic, and choreographic works, pantomimes, and pictorial, graphic, or sculptural works, including the individual images of a motion picture or other audiovisual work.

Copyright Formalities and Registration

Full protection under the copyright statutes requires the placement of a proper copyright notice and registration of the copyrighted work with the Copyright Office.

The copyright notice consists of: 1) The symbol © (the letter C in a circle), or the word "Copyright" or the abbreviation "Copr.", or in the case of sound recordings, the symbol ℗ (the letter P in a circle); 2) The year of the first publication; and 3) The name of the owner of copyright. Thus: © 1987 Jane Doe.

The copyright notice should be affixed to the copies of the work in such a manner and location to give reasonable notice of the claim of copyright. Publication is the distribution of, or the offering to distribute, copies of the work to the public by sale or other transfer of ownership, or by rental, lease, or lending. A public performance or display does not constitute publication.

Copyright registration is not required, but there are several advantages of registration, including: 1) Registration establishes a public record of the copyright claim; 2) Registration is necessary before any infringement claims can be filed in court; 3) If made before or within 5 years of publication it will establish prima facia evidence in court of the validity of the copyright and of the facts stated in the certificate; and 4) If made within 3 months of publication, statutory damages and attorneys fees will be available to the copyright owner in an infringement action. Otherwise, only actual damages and profits may be recovered.

To register a work requires sending the following to the Copyright Office: 1) A properly completed application form; 2) A filing fee of $10.00 for each application; and 3) A deposit of the work being registered. The deposit requirements vary in particular situations, generally it consists of two copies of the work. In the case of software, the source code is deposited, however, there are some special provisions to allow the author to protect any trade secrets.

Apart from the above, the Copyright Act has a mandatory deposit requirement for all workds that are published with a copyright notice in the United States. The owner of the copyright has the legal obligation to deposit 2 copies of the work for the Library of Congress.

The omission of a proper copyright notice will not invalidate the copyright in a work if: 1) The notice has been omitted from no more than a relatively small number of the copies distributed to the public; or 2) Registration of the work is made within five years after publication and a reasonable effort was made to add notice to all distributed copies after the omission was discovered; or 3) The notice has been omitted in violation of an express requirement in writing that as a condition of distribution of copies, they bear the prescribed notice.

Copyright Ownership

The copyright in the work of authorship immediately becomes the property of the author who created it. The term "author" encompasses all creators of works. The authors of a joint work are co-owners of the copyright in the work, unless there is an agreement otherwise.

In cases of "works made for hire", the employer is considered to be the author. A "work made for hire" is defined as: 1) A work prepared by an employee within the scope of his or her employments; or 2) A work specially ordered or commissioned for use as a contribution to a collective work, as part of a motion picture or other audiovisual work, as a translation, as a supplementary work, as a compilation, as an instructional text, as a text, an answer material for a test, or as an atlas, if the parties expressly agree in a written instrument signed by them that the work shall be considered a work made for hire.

Transfer Of Ownership

Any or all of the exclusive rights of the copyright owner, which were discussed above, can be transferred. However, the mere transfer of ownership of a copyrighted work or a copy thereof does not tranfer any rights in the copyright.

An assignment of a copyright is a transfer of all right, title, and interest in the copyright. The assignee becomes the copyright owner. An assignment must be in writing and should be recorded in the Copyright Office.

A license is a grant of the right to exercise one or more of the exclusive copyright rights. The rights granted by license can vary greatly according to the situation. Licenses should also be in writing.

Compilations and Derivatives

Compilations and derivative works are protectable by copyright. However, if the compilation or derivative work incorporates a copyrighted, preexisting work, permission must be obtained from the copyright owner.

A compilation is a work formed by the collection and assembling of preexisting materials or of data that are selected, coordinated, or arranged in such a way that the resulting work as a whole constitutes an original work of authorship.

A derivative work is a work based upon one or more existing works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgement, condensation, or any other form in which a work may be recast, transformed, or adapted. A work consisting of editorial revision, annotation, elaboration, or other modifications which, as a whole, represent an original work of authorship is a derivative work.

Duration of Copyright

Under the Copyright Act of 1976, a work created on or after January 1978 is protected for the life of the author plus 50 years, or in the case of a work for hire, 75 years from publication or 100 years from creation, whichever is shorter.

Copyright Law and the Employer

As discussed above, a work prepared by an employee within the scope of his or her employment would constitute a "work made for hire" and the employer would be considered the owner of the copyright. The Oregon State Department of Higher Education and many school districts and other public agencies have established policies for handling copyrights and patents for works created by their employees.

The policy of the Eugene 4J School District reads:

"3870 Copyrights and Patents

"A. District approved textbooks, guides, and other teaching materials provide the basic tools to assist teachers and administrators in reaching the instructional goals and objectives of the district. Staff members are encouraged to develop materials which enhance the district curriculum and assist in meeting the needs and interests of the students. Publications, materials, or models developed by an employee may be used in individual classrooms at the discretion of the teacher if the publications or materials are related to district goals and objectives and are used to supplement required materials.

"B. The district reserves the right to claim full ownership of publications, materials, models and other items developed by district staff on district time. The district may apply for copyrights and patents when deemed appropriate by the superintendent. In the event an employee develops educational materials, wholly or partly of district time, the employee may petition the district for assignment of copyright or patent rights; however, the employee shall not attempt to copyright or patent any such item or use the name of the district without the knowledge and consent of the superintendent. When the employee is granted copyrights or patent rights under the description of Paragraph B, the district shall be exempt from paying any cost for royalty or profit when purchasing such item.

The policies and procedures governing the employees of the Oregon State Department of Higher Education are found in the Oregon Administrative Rules, Chapter 580, Division 43.

Most, but not all, educators are hired to teach, not to create educational media. Therefore, the creation of such

media on the educator's own time would not be considered work made for hire. However, it is always wise to consult with an employer to determine whether the employer considers a creation or proposed creation to be within the scope of employment. It is also important to keep a record of development, to establish that the development was not conducted during work time.

The Contractual Relationship

Whenever there is more than one party involved in either the creation or the publishing of educational media, it is important that the parties come to an agreement with respect to the rights and responsibilities of each party. If any significant amount of money is involved, it would be prudent to consult with an attorney to assist you with the contracting process.

The contracting process is more than just going to an attorney to have a document drafted. It is a process that parties go through to assure that the various aspects of their relationship have been considered and clearly established. The aspects of the relationship are then memorialized in a written document. This document provides a process to follow for managing the relationship, for handling any difficulties that might arise, and for terminating the relationship.

The reason that an attorney is of assistance in the contracting process is that the attorney is in a position to objectively analyze the situation, to recognize potential areas of difficulty which have not been resolved by the parties, and to draft a document which is not ambigious. It is, however, the parties who should determine the relationship, not the attorney.

The topics that need to be considered when parties enter into a relationship are:

1) What is the relationship between the parties.

2) What are the respective duties and responsibilities of each party and what will happen if a party fails to perform.

3) What is each party representing to the other party that they have or are capable of doing and what will happen if that representation was incorrect.

4) What restrictions are there on the actions of the parties.

5) Who has ownership rights to any product(s) which may be developed during the relationship.

6) How long will the relationship exist, under what circumstances will the relationship be terminated and what are the obligations of the parties upon termination.

Discussing and reaching agreement on the above topics will greatly assist the establishment of a successful relationship.

Encouragement

New technologies offer exciting possibilities for the development of high quality educational media. To fully tap this potential will, in my opinion, require the cooperative relationships between educators, who understand needs of children and the process of learning, and technology wizards, who can take the capabilities of the new technology to its highest level. It is my hope that the information contained in this paper will provide some basis for the formation of successful relationships between educators and wizards. These tools provide the stable foundation, the castles are yours to build.

The Author

Nancy E. Willard is a Eugene attorney who practices in the areas of computer law, copyrights, trademarks, technology transfer and marketing law. She is also a former educator and is active in economic development activities in Oregon.